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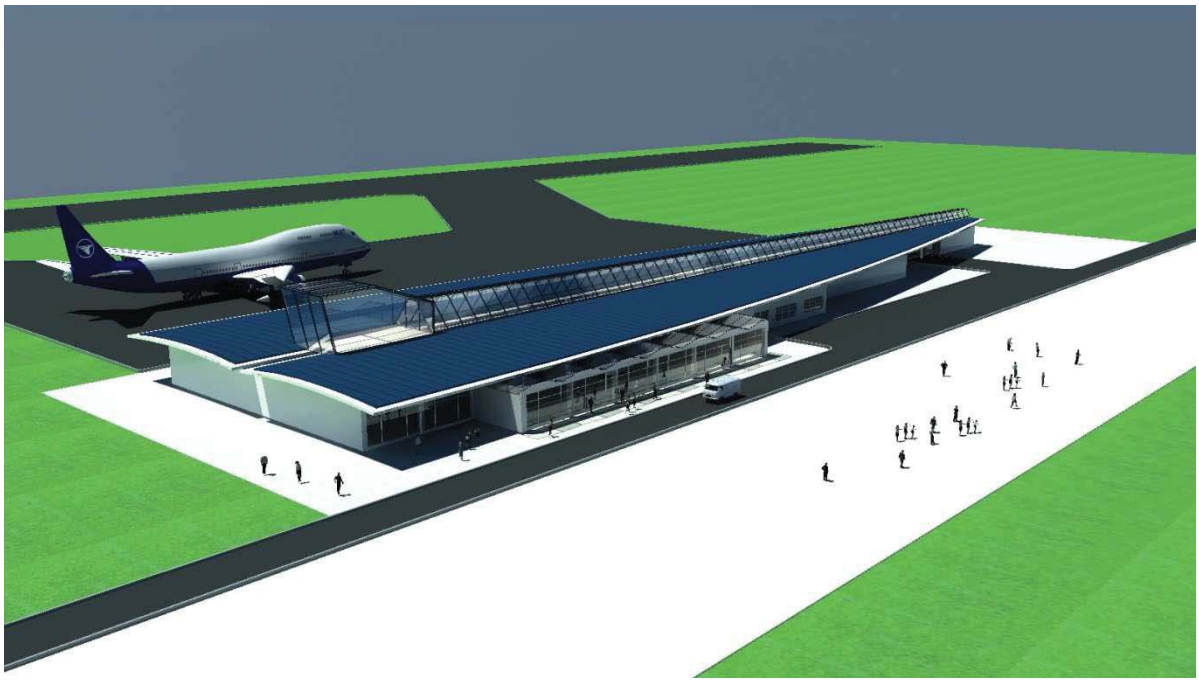

ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR OYU TOLGOI PROJECT PERMANENT AIRPORT

Ulaanbaatar, 2011

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БАЙГАЛЬ ОРЧИНД НӨЛӨӨЛӨХ БАЙДЛЫН НАРИЙВЧИЛСАН ҮНЭЛГЭЭНИЙ ТАЙЛАН

“ОРОН НУТГИЙН БАЙНГЫН ОНГОЦ БУУДАЛ БАЙГУУЛАХ” ТӨСЛИЙН БАЙГАЛЬ ОРЧИНД НӨЛӨӨЛӨХ БАЙДЛЫН НАРИЙВЧИЛСАН ҮНЭЛГЭЭНИЙ ТАЙЛАН

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Prepared by: **ENVIRONMENTAL STUDY AND INFORMATION CENTER "OS MT" CO., LTD**

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Project Locality **Khanbogd soum, Umnugobi aimag**

Soum Chaiman / Dendevsamba/

Ulaanbaatar, 2011

EXECUTUVE SUMMARY

The “Oyu Tolgoi” LLC is developing the Oyu Tolgoi (OT) Project to treat copper bearing sulfide ore from open pits and underground workings. The OT Project will be the largest in product output, financing capacity and capital investment in Mongolia.

The Oyu Tolgoi mine is located in Omnogovi Aimag (province), 570 km apart from the capital Ulaanbaatar of Mongolia, where has weak of infrastructure such as lack of highway and railway line. Therefore, an air transport plays important role for mining operation and activities.

This project has been developed to construct a new domestic permanent airport as near current temporary airport, which is located 12km from North of OyuTolgoi licensed area. For this purpose, an engineering project is designed to accommodate Boeing 737-800 series aircraft which could be landing and takeoff over type of runway.

According to conclusion on initial environmental examination of Minister for Nature, Environment and Tourism, it has been mentioned that detailed environmental impact assessment (Environmental Impact Assessment, EIA) is needed to be done further investigation. (Conclusion issued by Ministry for Nature, Environment and Tourism, August 2010, No 2010/B163).

On request of the “Oyu Tolgoi” LLC, The Environmental Impact Assessment has been done by “OS MT” Co.,Ltd, Environmental Consulting Company.

The EIA is based on existing Mongolian Law of Environmental Protection, Law of Plant Protection, Law of Environmental Impact Assessment and any other related Mongolian standards and environmental rules. The main objectives of the environmental impact assessment are:

1 To determine potential and main impacts during implementation phase of the current project and investigate the project implementation activities, its steps and technological solution.
2 To develop necessary recommendations during project implementation as well as environmental protection and natural rehabilitation plan, and environmental monitoring program

The EIA report consists of the brief description of the project to be implemented, fundamental environmental impact assessment, description of main and potential impact assessments, and recommendations necessary to mitigate impacts, action plan for nature protection, and rehabilitation and environmental monitoring program.

Experts of “OS MT” LLC is performed field survey in proposed area of new airport construction during the EIA stage and made some interview with local inhabitants of the KhanBogd soum. Also experts have introduced by The Report on Environmental Impact Assessment of Oyu Tolgoi Mining Project, Volume 3 (“Eco-Trade” LLC, 2006) and Baseline dust monitoring program at Oyu Tolgoi (“OS MT” LLC, 2006) and), The environmental impact assessment report of project on “Local airport movement in Ouy-Tolgoi”. (OSMT Co.,Ltd).

The operational new airport area has semi desert light brown soil with sparse vegetation, low precipitation amount, no surface water flow, strong wind and dust storm during all seasons. Chapter 2 presents a detailed description on it.

Chapter 3 gives potential impact assessments of consruction work of taking off/ landing runway length 3250 m, path, safety end strip, platform, aircraft place, maintenance service building, controlling towel, passengers terminal, waiting hall, car park, runway lighting, energy, fencing, water drainage system. For example,

- ✓ Soil erosion
- ✓ Disappearing of vegetation cover (it affects the bird's and mammal's habitats)
- ✓ Land topographical changes
- ✓ Soil pollution by waste from airport and fuel
- ✓ Air quality deteriotationduring waste, dust and noise increasing, soil stripping, construction work.

During construction work the folowing short term impacts may affect surrounding area as :

- ➦ Traffic increasing during construction materials, equipments transporting
- ➦ Dust increasing during contruction and ground work
- ➦ Human health impact during contruction work

During operational activity short term impacts as noise and vehicle traffic are available.

In this asseessment work the matrix method has been used.
Potential impacts were divided into 2 phase groups; during construction work and operational activity. In this chapter were described ecological environment(air, water, soil pollution, noise etc) impacts, biological resources(flora, fauna) impacts, human (land, road, water supply, power supply) impacts and socio-economic, health, historical cultural impacts.

Chapter 4 contains risks and emergency impact assessments during project implementation. For instance, considering potential risk scope, magnitude, consequences cases were identified firstly; emergency accidents and incidents, secondly: other industrial accidents. In relation with it in order to clarify implementation of actions to be taken before during and after of risks appearing in airport and subarea, eliminate un misunderstanding of participating bodies, identify activity workflows and coordination the "Emergency Procedures" should be developed and adapted according to new airport specifics. Therefore contracting with related organizations is important to prevent and reduce possible risks.

Chapter 5 gives recommendations on negative influences reducing during construction and operational activity. Especially project implementor's control and inspection are important during airport construction phase.

In Chapters 6 and 7 the environmental protection plan and environmental monitoring programme have been included. There land rehabilitation and solid and liquid waste removing, tree and vegetation planting issues are included.

The environmental protection plan implementation total budget is 37080.0 thous.tug with annual budget is 7416.0 thous.tug.

A EIA detailed report was introduced to herders and inhabitants living in near airport area of OT and distributed the questionnaire sheet . The most of them supported airport building up analysis on questionnaire is attached.

The environmental impact assessment work has been conducted by Prof. Dr. R.Mijiddorj, Dr.M.Bayasgalan; and geochemist Ts.Erdenestesteg from "OS MT" LLC; Dr. N. Nyamsambuu,

soil expert, Institute of Geography engineer MAS, Dr. Sanjid, vegetation expert, Institute of the Botany, MAS, Dr.D.Oyunbaatar, hydrological expert and MSc. P.Gombolundev, meteorological expert, Institute of Hydrology and Meteorology.

Finally we would like thank R.Bumdari, G.Erdenetuya , S.Otgonbaatar and other staffs of Ouy-Tolgoi LLC for their support, assistance and providing by information to perform this environmental impact assessment report on peremnant airport project.

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1. BRIEF DESCRIPTION OF THE PROJECT

1.1 Name of the project

Oyu Tolgoi Project Permanent Airport

1.2 Type of environmental analysis

According to classification of Environmental Impact Assessment Project, the project belong infrastructure development project.

1.3 Project Scope

OT LLC, formerly called Ivanhoe Mines Mongolia Inc Co.,Ltd , is developing the Oyu Tolgoi copper and gold project located in the South Gobi region of Mongolia. Oyu Tolgoi (OT) consists of a series of deposits containing copper, gold, silver and molybdenum. The deposits stretch over 12 km from the Hugo North deposit in the north through the adjacent Hugo South, down to the Southern Oyu deposit and extending to the Heruga deposit in the south. The Oyu Tolgoi Project will involve both surface and underground activities feeding ore to a central processing facility which will produce copper concentrate.

The proposed permanent airport will support the development of the OT mine and its ongoing operation. Allowing fast, efficient passenger movement from the OT mine site to Ulaanbaatar.

1.4 Project Executor

Oyu Tolgoi LLC,

1.5 Project Location

The Oyu Tolgoi mine is located 570 km south of Ulaanbaatar, the capital of Mongolia. The mine is located in the Aimag (Province) of Omnogovi, the south Gobi region of Mongolia.

Project elevation: 1195 m above sea level (3870 ft)
Project longitude: 4 777 988 N (UTM48)
Project latitude: 650 191 E (UTM48)
Construction map based on 180 km/hour, (50m/sec) and 0.18g seismic load

OT LLC has developed project to build up permanent airport in north of local temporal strip, to north at 12 km distance from Oyu-Tolgoi mining project area (Figure 1.1, 1.2)..

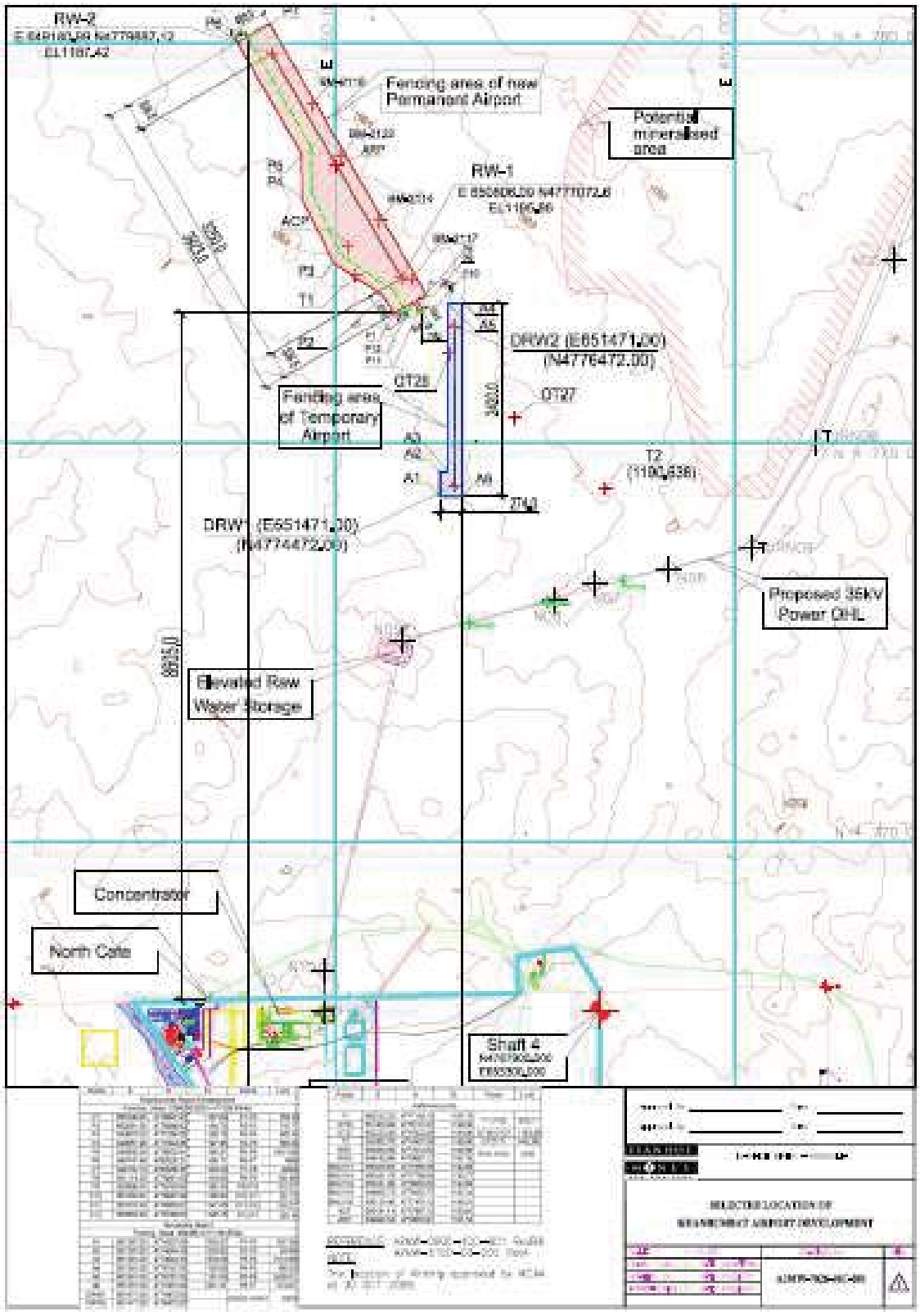


Figure 1.1. New airport location

Figure 1.2. New airport airstrip environmental condition

Involved all work for construction and operational phase of the permanent domestic airport is included this project.

Under this project framework, to develop design of the airstrip map of Boeing 737-800 series aircrafts, which could be landing and takeoff over solid type of runway, and their involved construction work has planned as to build long concrete runway strip, taxiway, runway end safety area, apron 4500m (for placing and maintenance), 3 storey control tower 100m2, passenger terminal, waiting hall of 120 passenger capacity, parking area, taking off/landing area signs, lighting, power, fence and surface water discharge channels.

1.6 Infrastructure

Terminal building, control tower, aircraft parking and placing and maintenance building will be newly constructed. Area of total terminal building is 1500m2 and passenger terminal has waiting hall with 120 passenger capacity. Control tower has 3 floors and area of fist floor is 100m2.
Total area including aircraft parking place and maintenance building is occupied approximately 4500m2.

Land and takeoff runway of the airstrip, terminal building, control tower, aircraft parking place are protected by iron fence, which is 1.8 m height.

About 5.2km long paved road will be built from current Oyu Tolgoi-Khanbogd road to terminal building, which is located at front of new runway of land and takeoff of airstrip.

Also, restroom will be built and its used water is collected in the ground floor room, and finally it is carried by cars to the integrated sewage system point at the Oyu Tolgoi. Control tower is located upward to the passenger terminal.

Power generator with 40kV will place underground near terminal building and its requested fuel is transported by cars. Therefore, it is not need to keep fuel near the power generator.

Water tank is located near terminal building and it pumped by small size of power pump for supplying water of restroom in the terminal.

1.7 Geotechnical & Hydrogeological work

Geotechnical survey is performed to explore resource of necessary building materials from local area such as to determine feature of landfill material, mechanic properties and background soil layers of landing and takeoff of the runway, and to construct dam and surface.
Output and result of survey is used in developing detailed map of landing/takeoff runway, building background layer and dam, determining their depth, and designing of general and working map. Furthermore, recommendation and suggestion of flood protection of landing/takeoff airstrip will be issued based on hydro-geological exploration.

Investigation of possible building material used in landing/takeoff runway has been done at local area and a distribution of particle fraction with size 5-10mm, 10-20mm, 20-40mm and 40-80mm are determined as well.

Currently, investigation study of suitable building materials is continuing and it is anticipating that possible to use building materials obtained from the airport site or from existing areas of disturbance associated with the Oyu Tolgoi project. Therefore, there is no plan to import building materials from new undisturbed sites outside the project area.

To procure equipment, which is suit for quality and size of landfill material, it is needed to select carrier equipment, filter, graining and sorting machines. Pressure loading of the materials resistance is less than 600kg/m2.

According to preliminary consideration, slope is from CH20+30 to CH 10 /1030m/ with 0.8%, from CH10 to CH5 /500m/ with 0.2 % and from CH5 to CH-1+70/530m/ with 0.3%. Ratio of digging and filling approximately 198 609 m3 /digging/ x139 173m3/filling/. Currently, determining filling materials is going on.

1.8 Flight Frequency

Frequency of flight is 1time per day after starting operation of landing/takeoff runway

1.9 Fuel Storage

Aircraft flying from Ulaanbaatar to OuyTolgoi will be fully fuelled prior to departure and there is no need to build fuel saving facility at OuyTolgoi site.

1.10 Relevant report of study

- Report documents of Oyu Tolgoi Project. Office of IMMI, 2003
- Report of dust measurement at Oyu Tolgoi area. "OS MT" LLC. 2004
- Meteorological Data of the Oyu Tolgoi March-May 2003
- Observed Dust Storm Data of Khanbogd Meteorological Station. 1975-2005
- Report documents of Environmental Impact Assessment of the Oyu Tolgoi Project. "Eco-Trade" LLC. 2006.
- Report for archaeological survey works at the Oyu Tolgoi new airport, 2006
- Dust Monitoring Program at Oyu Tolgoi region. "OS MT" LLC. 2006.

1.11 Methodology

The methodology basically is based on procedures of Law of Mongolia Environmental Assessment (2010. Ulaanbaatar)
The investigation methodology includes the following steps:

- To gather and review relevant reports and documents of the environment outlook, photos and maps of the project area.
- Field surveys to gather additional information.
- To describe positive and negative impact of construction and operational phase activity of the airport to the air, water and soil pollution, and society and economy.
- To summarize nature protection plan, environmental monitoring program and recommendation to reduce negative impact.

2. EXISTING ENVIRONMENTAL CONDITIONS

2.1 Physical resources

2.1.1 Climate regime in Oyu Tolgoi area

The Oyu Tolgoi region corresponds to very dry, warm climatic zone, according to the definition of climate zones (B.Jambaajamts, 1989). Annual precipitation is low (less than 150 mm), there is no permanent snow cover during winter and strong winds occur frequently in the region.

2.1.1.1. Air temperature

A significant feature of this region is that topographic influence is low and zonal temperature distribution is conserved in whole seasons. The region is relatively warm and dry compare to any other part of Mongolia. There is big seasonal difference of temperature, cold winter and hot summer.

According to zonal distribution of temperature, in winter mean temperatures are -11.0^{0}C to -13.0^{0}C (Figure 2.1a) and in summer, mean temperatures are 20.0^{0}C to 22.0^{0}C (Figure 2.1b). Year to year variation of mean temperatures are dependent on the specific year's conditions.

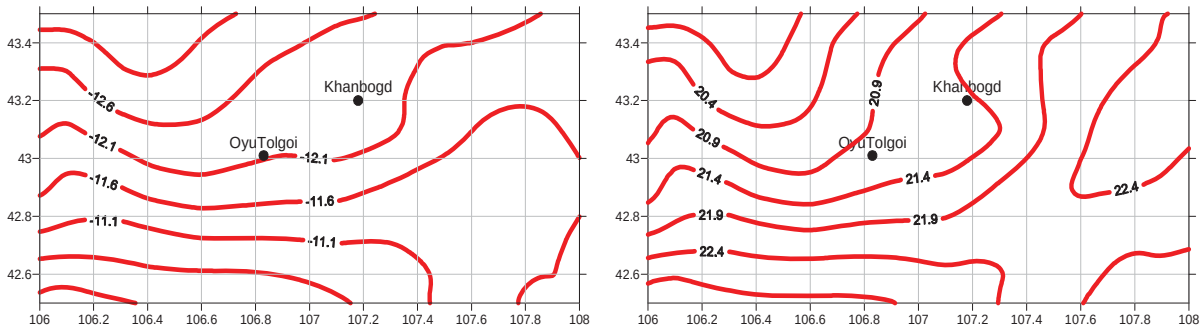


Figure 2.1. a) Winter, b) Summer temperature distribution field, ^{0}C

2.1.1.2. Precipitation

Varies from 2.5 mm to 3.5 mm of snow over winter which is 10% of the annual precipitation (Figure 2.1a). In summer, the amount of precipitation is 70 mm to 95 mm (Figure 2.1b).

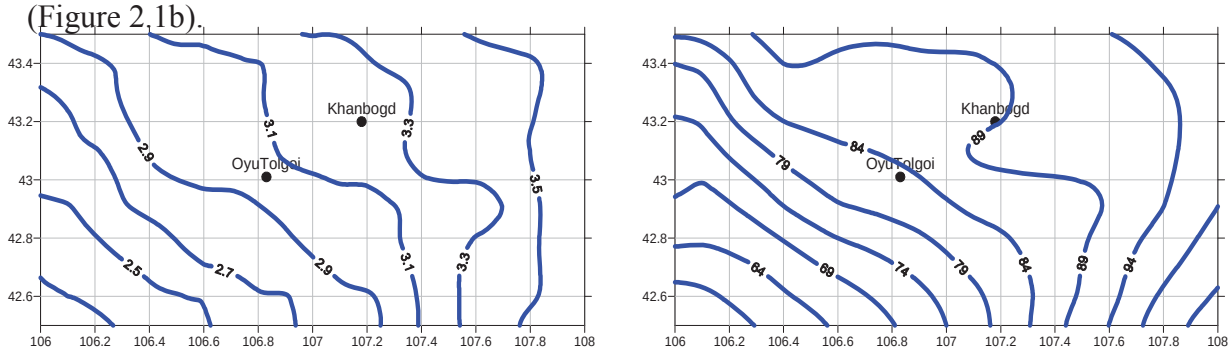
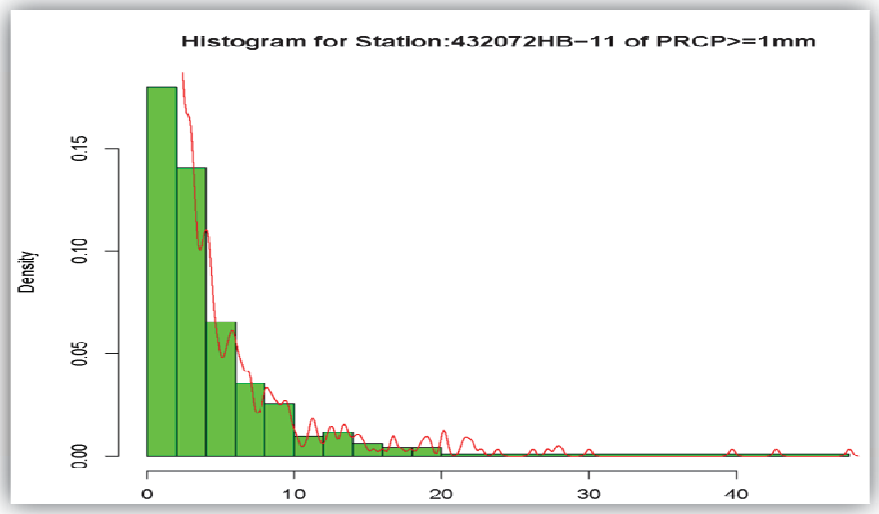


Figure 2.2. a) Winter **b) Summer precipitation distribution field, mm**



c) Distribution function of the daily precipitation

The summer rain is comparatively greater intensity than winter and the evaporation is also higher due to the warm surface conditions.

Absolute daily maximum precipitation is 47.7 mm and most case it is less than 10mm. (Figure 2.2 c).

The meteorological Khanbogd station near Oyu Tolgoi region was established in 1975. Table 2.1 and 2.2 show monthly averages for the 1976-2005 period of air temperature, precipitation, relative humidity, air pressure and wind direction occurrence with corresponding average wind speed.

Table 2.1. Climate mean of Khanbogd station within 1976-2005

Elements	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Air temperature, ^{0}C	-11.5	-7.1	-0.5	8.8	16.5	22.1	24.6	22.2	16.4	7.8	-2.3	-9.2
Precipitation, mm	1.1	1.1	2.7	3.1	7.7	11.4	23.9	28.8	7.3	3.4	1.6	0.7
Relative humidity, %	52	42	33	28	30	36	42	44	38	37	42	50
Air pressure, mb	893.8	860.7	890.0	886.8	885.3	882.3	881.3	884.5	889.5	893.0	893.8	894.6

Table 2.2. Climate mean of wind at Khanbogd station within 1976-2005

		NE		E		SE		S		SW		W		NW		N	
Month	Calm	Ocu	Spe	Ocu	Spe	Ocu	Spe	Ocu	Spe	Ocu	Spe	Ocu	Spe	Ocu	Spe	Ocu	Spe
Jan	32.1	4.6	4.4	1.8	2.6	0.6	1.3	1.2	3.0	23.8	6.8	31.1	5.6	29.0	5.8	7.8	5.3
Feb	31.5	7.8	8.4	3.0	4.6	2.2	3.2	2.0	2.5	19.7	6.1	28.1	5.5	26.5	5.9	10.7	7.3
Mar	25.8	9.4	5.2	5.8	4.5	4.0	4.0	3.0	3.4	16.9	5.9	22.8	5.9	26.1	6.6	11.9	6.2
Apr	19.0	9.7	6.4	5.5	4.4	4.8	4.2	4.4	4.4	17.7	6.4	21.2	6.6	23.7	7.7	13.1	6.9
May	21.0	12.1	6.2	7.1	5.0	3.9	4.1	5.3	4.7	17.1	6.0	19.1	6.2	21.7	6.9	13.6	6.9
Jun	26.2	13.3	5.3	7.9	4.4	7.4	4.4	7.8	4.7	14.3	5.7	16.1	5.6	17.7	5.9	15.5	5.9
Jul	31.0	12.4	4.8	8.6	4.5	8.5	4.4	8.4	4.7	15.5	5.6	14.1	5.3	19.1	5.5	13.4	5.2
Aug	35.4	10.8	4.6	9.5	4.3	8.1	3.8	10.5	4.2	16.5	4.8	15.3	5.1	16.7	5.3	12.6	4.8
Sep	33.2	8.6	5.1	6.8	4.2	5.4	3.9	6.7	4.0	19.6	5.1	21.1	5.5	20.3	5.7	11.5	5.3
Oct	28.4	6.7	4.9	3.9	4.3	2.2	2.6	3.1	3.5	20.9	5.6	29.4	5.6	23.4	6.2	10.3	5.7
Nov	24.9	4.1	5.2	1.8	2.7	0.9	2.1	1.5	3.6	24.0	6.6	33.3	5.9	27.0	6.4	7.4	5.7
Dec	28.3	4.2	4.3	1.5	2.8	0.7	1.8	1.2	2.4	25.9	6.9	32.0	6.0	27.6	5.7	6.8	5.0

2.1.1.3. Climate change and future trends

When consider climate change in the last decade, the regional climate model (RegCM3) simulation outputs within the 1993-2002 periods is interpolated to the 43.01', 105.83' point at the Oyu Tolgoi region using a bilinear interpolation method. Finally, the inter-annual variability of climate and hydrological elements and their changes are simply defined.

The monthly maximum, minimum and average air temperature time series is depicted in Figure 2.3. Trend lines show whole temperatures are increasing consistent with global climate warming. However, apart from a small increasing trend, the hydrological elements such as precipitation, evapotranspiration and surface runoff are not significantly changed (Figure 2.4). This coincides with results that precipitation has increased in eastern parts of Mongolia.

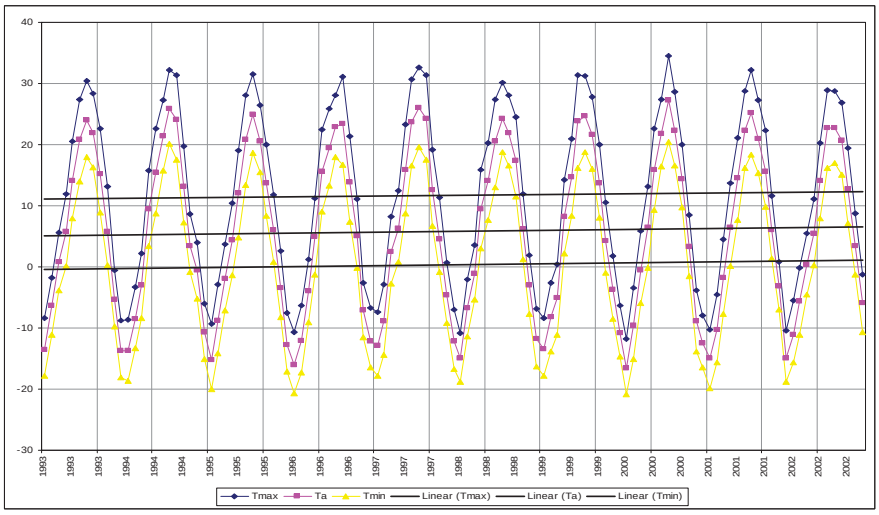


Figure 2.3. Monthly maximum, minimum and average air temperature time series within 1993-2002

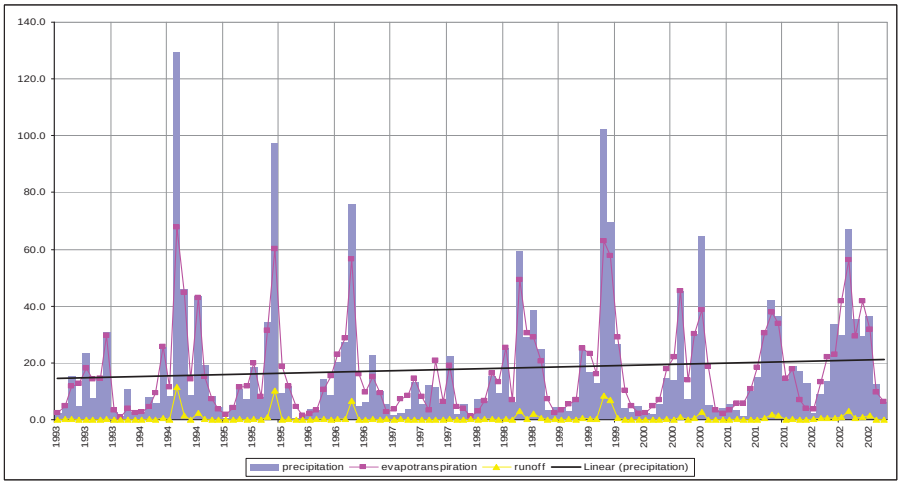


Figure 2.4. Precipitation, evapotranspiration and surface runoff time series within 1993-2002

Future climate change scenarios in the Oyu Tolgoi region are represented in the following Table **2.3.**

Table 2.3. Future climate change scenarios in Oyu Tolgoi region

	Temperature, ^{0}C			Precipitation, mm		
	2020	2050	2080	2020	2050	2080
Winter	0.38	2.25	4.13	3.3	8.0	15.3
Summer	1.89	3.22	6.05	5.3	20.8	27.2

The main point of interest is both the increase in temperature and the amount of increased precipitation is greater in summer than in winter, but in respect to their climate mean, winter precipitation will increase more. These scenarios are based on A2 GHG special emission scenarios of the Intergovernmental Panel on Climate Change (IPCC) organization.

2.1.1.4. Dust Storms in Khanbogd stations

One of main reason of soil erosion is strong wind and its related dust storm. Due to dust storm, air pollution increases and a visibility gets worse, finally this condition is negatively affected aircraft landing/takeoff.

Dust storm is divided 3 categories such as dust storm, drifting dust storm and dust (sand) hurricane. Visibility and air pollution gets worse due to transportation of dust and aerosols and it is named as dust fog /floating dust/. In weather observation guide, the dust and aerosols released into air due to strong wind, and it causes abrupt worst visibility. Such phenomenon is called as dust/sand storm. Dust and aerosols blows near the surface at 1.5-2.0m height/less than eye level of observer/ and it calls drifting dust storm. Dry soil dust particle, sand, biological particle are released from earth surface to atmosphere and it is named as floating dust into air. This kind of dust forms when abrupt decreases of wind speed and sometimes increases of temperature occur. This condition is reduced visibility up to 6km or less. The dust storm depends on soil surface condition.

Dust storm observation made by visual and special equipment using consideration of visibility.

Khanbog meteorological station was established 1 of December, 1975. Therefore, data from 1976 to 2005 is used to explore frequency of dust storm, daily and yearly dynamic and trends, wind direction and speed, visibility, humidity and soil surface condition during dust storm.

Number of day with dust storm: Dust storm occurs in the place where erosion soil and high frequency wind has. Soil destroyed by human activates in the city has more frequent dust storm occur compare to the surrounding environment. Number day with dust storm in year is nearly is 26 days in Khanbogd soum and number day of drifting dust is same as 26 days as dust storms.

In terms of soil erosion and its factor, it needed to consider both dust and drifting storm. Hence, we determine dust blowing days as sum of dust and drifting storm days. In Knanbogd soum number of dust blowing days is nearly 52 in year.(Table 2.4)

Annual dynamic of dust storm: Dust storm has annual dynamic, which is related movement (north and southward direction) of mid latitude frontal zone and cyclone development. The maximum frequency of sum of dust and drifting storm is occurs in spring (49.2%) as well as in summer (28.8%). Minimum frequency is occurred in autumn (10%).

Table 2.4. Number of days with dust storms and drifting dust storms at Khanbogd station

Type of dust storm	Month												Annual sum
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Dust storm	1.4	1.1	3.4	5.5	6.1	5.2	2.4	1	0.3	0.6	1	1.2	26.4
Drifting storm	2	1.5	2.4	3.8	4.8	2.9	2.4	1.3	0.9	1.2	1.4	1.8	26.4

Daily dynamic of dust storm. Dust storms also have a significant daily variation in Mongolian steppe and Gobi region. The frequency increases during the day time and decreases during the night. During the day time dust and aerosol blow due to heated surface and unstable conditions of air, and during the night time it is opposite.

In terms of daily dynamic of the dust storm, its frequency is 75% from 9am to 9pm, 25% from 9pm to 9am and 44.1% from 12am to 18pm as respectively. (Table 2.5)

Table 2.5. Duration of dust and drifting storm in spring, Khanbogd soum, %

Time, %	Time, hour							
	0-3.0	3.1-6.0	6.1-9.0	9.1-12.0	12.1-15.0	15.1-18.0	18.1-21.0	21.1-24.0
Dust storm duration	5.2	5	6.5	12.9	20.3	23.8	18.6	7.7

Duration of the dust storm: Dust storm blows 102 hours and drifting storm is 72 hours in near Khanbogd soum region. Maximum duration of dust storm observes from March to May depending on its frequency. In spring season, the dust storm blows nearly 77 hours. (Table 2.6)

Table 2.6. Duration of dust storms /hours

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dust storms	7.4	3.5	15.5	26.2	25.4	8.8	2.2	0.6	0.4	2.3	4.9	6.8
Drifting dust	10.4	3.9	7.6	12.6	13.6	4.6	3.7	2.5	2.1	3.1	5.8	6.9

To calculate the average duration of a dust storm in one occurrence, the duration of dust storm occurrences over whole study years was determined and it was divided by the total number of dust storm occurrences over the study years. In this way, the average duration of dust storm (drifting dust) occurrence at Khanbogd soum is 4.1 hours for a dust storm and 3.0 hours for drifting dust (Table 2.7).

Table 2.7. Dust (drifting) storm duration in one occurrence (hour)

Station	Dust storm	Drifting storm
Khanbogd	4.1	3.0

A dust storm (also drifting dust) lasts on average from 1.6 to 6.0 hours and in the Gobi sometimes more than 12 hours. If the average duration of a dust storm (also drifting dust) occurrence is more than 6 hours then its frequency decreases. This is shown for the Khanbogd station in Table 2.8. The duration of a dust storm occurrence is longer in spring.

Table 2.8. Frequency (%) of duration of dust storms at Khanbogd station

Type of dust storms	Time intervals, hours									
	≤1	1.1-3.0	3.1-6.0	6.1-9.0	9.1-12.0	12.1-15.0	15.1-18.0	18.1-21.0	21.1-24.0	24.1≤
Dust storms	19.6	32.6	26.8	10.3	5.0	2.7	2.4	0.6	0	0

Meteorological conditions during dust storms

Surface wind: Southwesterly, westerly and northwesterly winds are predominating during dust storms in the Gobi and steppe areas in Mongolia. If surface wind speed is less than 5 ms^{-1}, a dust storm does not form. Surface wind speed is usually between 11 ms^{-1} to 20 ms^{-1} during dust storms, and 6 ms^{-1} to 15 ms^{-1} during drifting dusts. The frequency of surface wind speed at Khanbogd station during dust storms is shown in Table 2.9.

Table 2.9. Frequency of wind speed, %

Type of dust storms	Wind speed intervals, m/s					
	≤5	6-10	11-15	16-20	21-25	≥ 26
Dust storms	0	11.5	46.5	38.4	2.3	1.3
Drifting dust	0.1	27.2	62.1	10.5	0	0

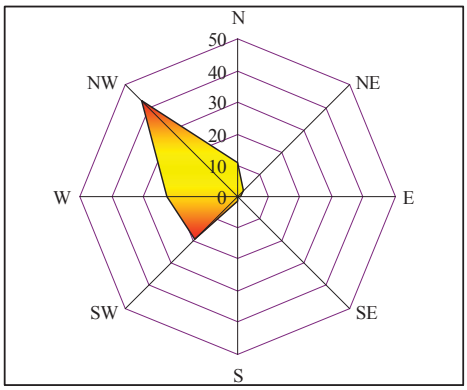


Figure 2.5. Frequency of wind directions at Khanbogd station during dust storms, %

The dominant wind direction during a dust storm is northwesterly (43%) (Figure 2.5).
Visibility: During dust storms at Khanbogd station visibility is mostly (42%) nearly 10 km and sometimes it is less than 1 km (13%) (Table 2.10, Figure 2.6).

Table 2.10. Visibility (km) during dust storms at Khanbogd station

Visibility (km)	0.05	0.2	0.5	1	2	4	10	20	50
Frequency, %	2.6	10	5.7	4.4	6.6	12.3	41.7	15.4	1.3

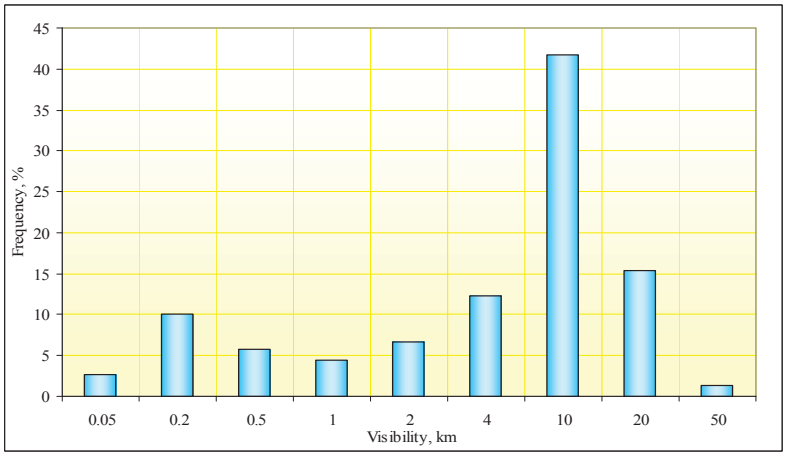


Figure 2.6. Visibility (km) during dust storms observed at Khanbogd station

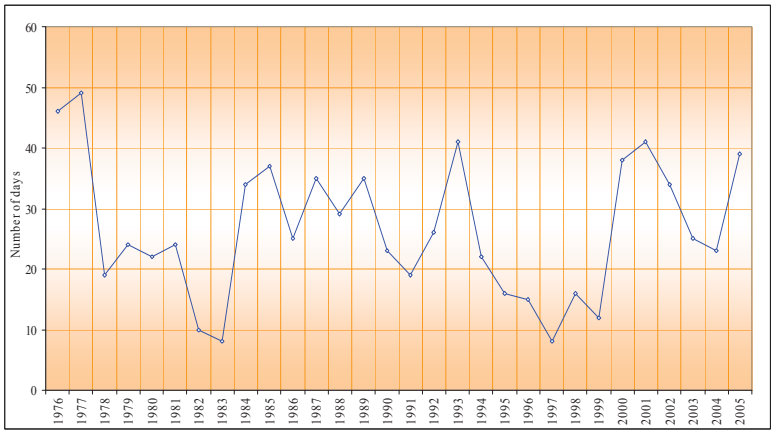


Figure 2.7. Time series of dust storms observed at Khanbogd station 1976 to 2005

Relative Humidity: Dust storm usually observes in day time, when relative humidity reaches to low value. In Gobi region, frequency of relative humidity is less than 40% is 63.1% in Gobi region, when dust storm forms.

Soil surface condition: In Kanbogd soum, soil surface condition is determined by observation data in the morning 8 am. As its results, 80% of dust storm occurs in, when soil was dry out.

Time series of dust storms were derived from the number of days with dust storms per year (without drifting dust) obtained from Khanbogd station in Umnugobi aimag, Mongolia from 1976 to 2005 (Figur2.7).

Figure 2.7 shows that the number of days with dust storms has a slightly decreasing trend during the period. Dust storm frequency was lower in 1978-1983, 1990-1991 and 1994-1999 and higher in 1976-1977, 1984-1989, 1993, 2000-2001 and 2005. These periodical changes may be dependent on annual frequencies of cyclones and strong wind, and precipitation. In addition, it may concerns with soil erosion in urbanized areas.

2.1.2 Geology and Landscape

2.1.2.1. Relief

According to the engineer-geological, regionalization of this area belongs to the Khanbogd-Sainshand district, Gobi-Herlen part of the Gobi-Mongolian east region with rock outcrops and hilly-rocky plain areas. Seasonal soil freezing is about 2 m in loamy and 3 m in sandy soils. According to Mongolian cryolithological regionalization, the study area belongs to the Gobi south region of seasonal freezing. (Figure 2.8, 2.9)

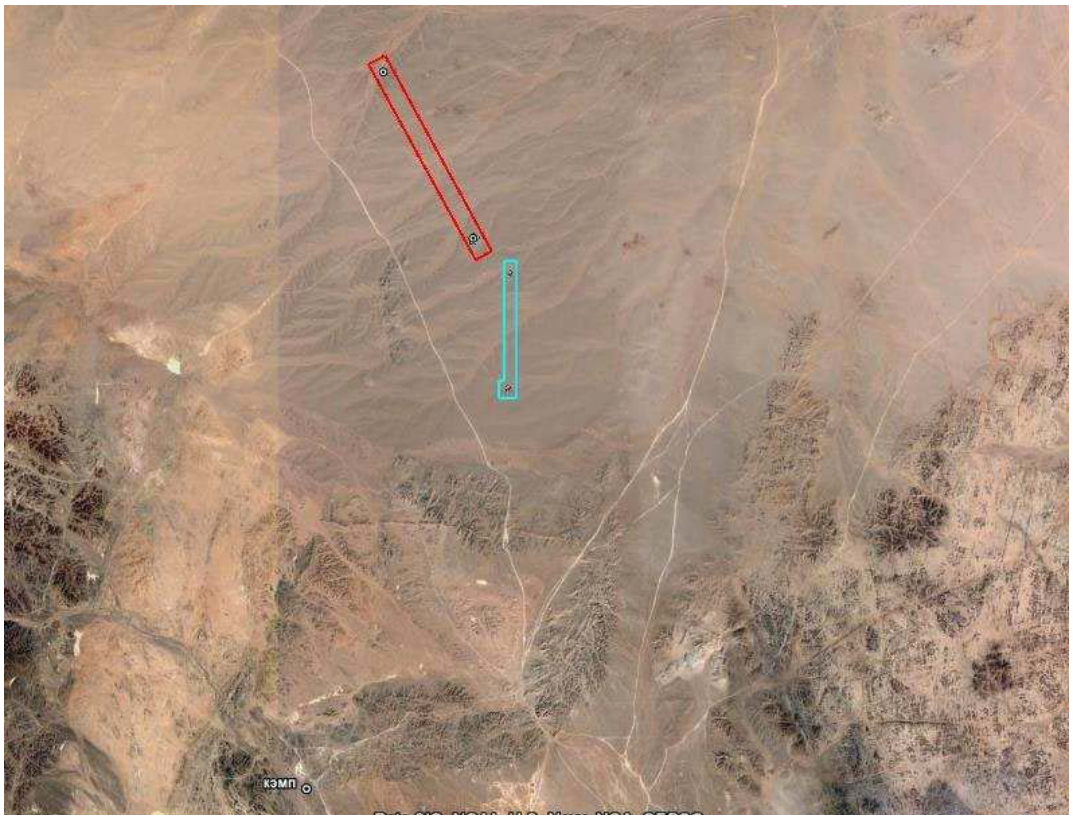


Figure.2.8. New planned (red) and existing (cyan) strips at Ikonos image

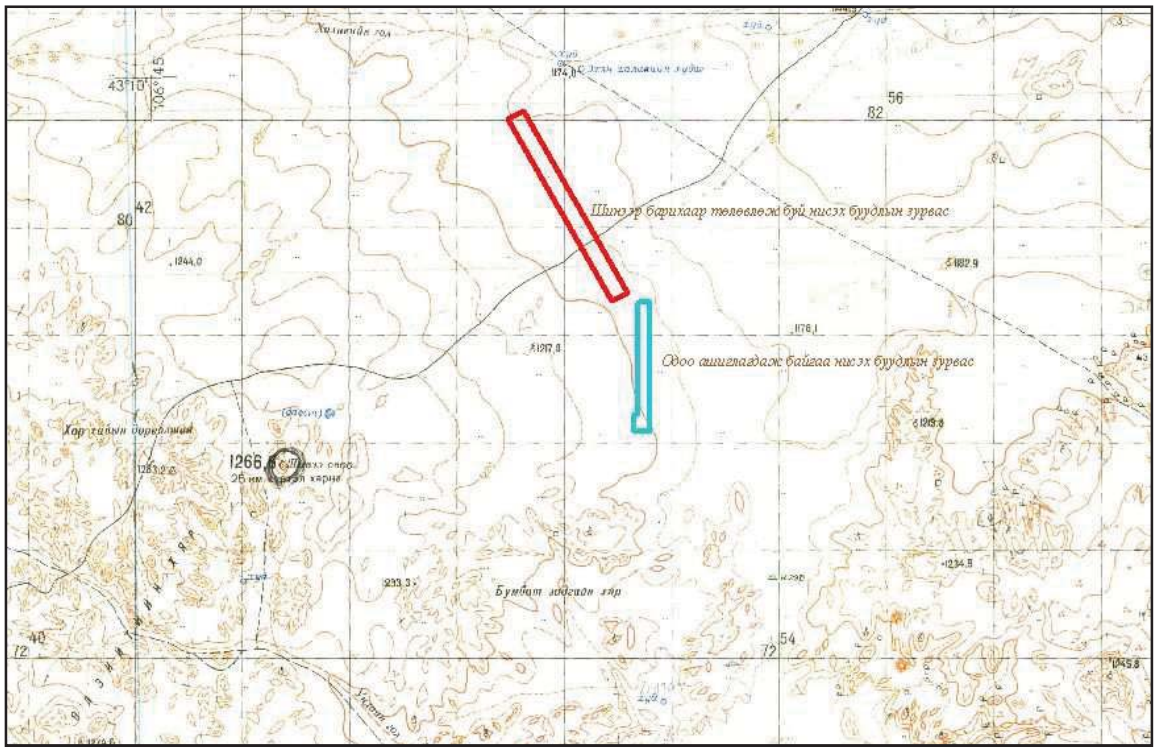


Figure.2.9. New planned (red) and existing (cyan) strips at topograph map (Ì1:100000)

Soil. According to the Mongolian soil-geographical regionalization, the study area belongs to the Gobi region latitudinal belt district [1]8 with *Semi desert light brown* soils of the Central Asian great region, characterized by the distribution of s*emi desert light brown, semi desert gravelly and shallow light brown, semi desert light brown solonetzis, solonchak* and *solonetzic meadow soils* (Dorjgotov.D, 2003). The following soil profile represents the morphological and chemical properties of *Semi desert light brown* soil.

2.1.2.2. Soil description

Profile OT-10-01. This soil profile was taken in the south-east from new airport in plate area with vegetation of low needle grass (anabasis-stipa gobica) composition. This site is covered by gravel; sparse vegetated with coverage less than 10%. The surface is covered by gravel; vegetation coverage is poor not exceeding 10% of coverage (Table 2.11)
Soil profile taken at:

650805.0 E
4777091.0 N h – 1183 m

Profile OT-10-01

The land surface is predominantly undulating plain with relative elevations of 2 m. The surface is covered by sand gravels and 15-25% plant coverage.

Geographic location (UTM) N4774965, E652331; H=1175 m
E 0-1.0 sm. Light brown, slightly hard, weak thin platy structure.
Aq 1-3 sm. Light brown, sandy loam, moist after rain, soft, low vegetation roots, and fine granular structure, gravel content 10-20%, gradual color transition
B 3-14 sm. Light brown, sandy loam texture, moist, low vegetation roots, granular structure.

Bca 14-30 sm. Light brown, sandy loam texture, moist, soft, granular structure, rare vegetation roots, carbonate accumulated.

Soil: Semi desert light brown

Profile OT-10-02. This soil profile was done in north edge of new airport site at rills and gulley with uneven surface, where water drains during raining, there a lot of small caragana accumulating sandy and gravel with brown Reaumuria and Stipa Gobica vegetation composition.
Soil profile taken at: 649133.0 E

4779979.0 N h – 1179 m

E 0-1 см. Light brown, dry, slightly platy, thin clayed layer.
Aq1-3 см. Light pale brown, sandy loamy, dry, slight hard, dried low vegetation roots, granular structure, clear transition.
Ak 3-10 см. Pale brown, sandy loamy, dry, slight hard, sparse distribution vegetation roots, granular structure, and clear transition.
B 10-22 см. Yellowish brown, sandy loamy, dry, hard, angular blocky structure.

Bfeca 22-31 см. Yellowish pale brown, sandy loamy, dry, hard, carbonate accumulated, gravels are 30-40%, angular structure, clear transition.
Bca 31-40 см. Light brownish gray, loamy sandy texture, dry, hard, high accumulation carbonate, fine granular structure.

Soil: Semi desert light brown solonetzic

Soil nutrient.

salt. The distributed mobile phosphorus content in 100g soil ranges 0.64-0.90 мg at in top soil with decreases to 0.27 mg with depths. The potassium content in 100 g soil is 11.0-13.0 мg with decreasing to 2.5 mg at layers depth 15 sm and lower.

Table 2.11. Soil texture, mm/%

Profile ID	Depth,sm	Sand			Silt			Clay	Content of clay, %	Connectivity capacity
		Very coarse	Coarse	Fine	Very coarse	Coarse	fine			
		2-1	1-0.25	0.25-0.05	0.05-0.01	0.01-0.005	0.005-0.001	<0.001	<0.01	
Semi desert light brown										
ÎÒ-10-01	0-14	4.86	24.10	54.00	8.20	0.80	6.16	1.88	8.84	8.6
	14-30	5.78	25.97	52.98	5.32	1.76	4.08	4.12	9.96	9.8
	30-40	12.36	22.49	49.79	6.88	0.04	8.08	0.36	8.48	6.1
Semi desert light brown solonetz										
ÎÒ-10-02	0-22	3.13	21.45	52.03	5.68	2.40	4.56	10.76	17.72	18.9

Table 2.12. Soil chemical basic characteristics

Profile ID	Depth, sm	pH H_2O (1:2.5)	$CaCO_3$ %	Humus %	Mobile element, мг/100гр		$EC_{2.5}$ dS/m
					P_2O_5	K_2O	
Semi desert light brown							
OT-10-01	0-14	8.88	0.73	0.33	0.70	11.0	0.068
	14-30	9.05	1.14	0.24	0.64	3.0	0.061
	30-40	9.26	1.14	0.13	0.27	2.5	0.076
Semi desert light brown solonetzic							
OT-10-02	0-22	8.76	4.60	0.46	0.90	13.0	0.102

The humus contents in Semi desert light brown soil are 0.33% at 0-14 sm, 0.24% at 14-30 sm, 0.13% at 30-40 sm accordingly as seen table 2.10. Soil pH is 8.88 and alkaline, it increased to pH= 9.26 with depths. Carbonate content is 0.73% at top soil and 1.14% at lower layer with gradual increases. The electrical conductivity capacity (EC) is 0.61-0.076 dS/m that means no salty. (Table 2.12)

The humus contents in Semi desert light brown solonetz soil are 0.46% at 0.22 sm, soil reaction pH 8.76 indicates alkalinity, and carbonate amount is 4.60% exceeding normal value. The electrical conductivity capacity (EC) is 0.102 dS/m, that means no

Soil texture analysis shows clay content (< 0.01 mm) in Semi desert light brown soil are 8.48-9.96% at depth 40 sm gives to classify as sandy soil texture according to the Kachinski classification.

The clay content in semi desert light brown solonetz is 17.72% identifying sandy loamy soil texture.

To assess soil stability by structure connectivity capacity the following formula is used. If soil structure connectivity capacity more than 50%, soil will be affected not significantly.

$$S = 34.7 + 0.9x_1 - 0.3x_2 - 0.4x_3 \quad (1)$$

S - Soil structure connectivity (%)

x_1 - Clay content (particles < 0.001 mm, by %)

x_2 - Fine sand (0.05-0.25 mm, by %)
x_3 - Coarse and medium sand (0.25-3.00 mm, by %)

The above calculation results show that soil structure connectivity (S) of semi desert light brown soil ranges 6.1-9.8% at all layers, indicating less stable, more sensitive to water and wind erosion. The soil structure connectivity (S) of semi desert light brown solonetz soil is 18.9% at depth 0-22 sm, also less stable, sensitive to water and wind erosion although value is increased.

2.1.3 Surface water

The main factor for the formation of the surface water is a rainfall and a winter precipitation is not exceeded 4 mm in this region. Due to the influence of cyclone and convection, 80-90% of the annual precipitation falls in summer season. During the summer season, about 80-100 mm rainfall falls in the western part of the area while 60-80 mm in the central part and 30-60 mm in the eastern area (due to topographic effect in mountain areas, summer rainfall amount may reach 60-80mm). However, precipitation intensity is comparatively high and evaporation also is high due to the heating of the land surface in this region.

The precipitation intensity is most important factor for the formation of the surface water in this region. Lowest annual and monthly precipitation observes in this area compare to the other part of Mongolia. But intensity of daily rainfall is crucial in this area.

A time series of daily precipitation shows that maximum precipitation is 153 mm and observed in 1956 and minimum is 53 mm and observed in 1979 (by the Dalanzadgad meteorological station of IHM). Daily, 12 and 1 hourly maximum precipitation with probability of occurrence of 1 % are 148.6, 125 and 50.6 mm, respectively. Daily maximum precipitation with 1000 year return period was estimated as 517mm and it is 3.5 times more than long term average annual precipitation (P.Gomboluudev, 2006).

2.1.3.1 Surface water of study area

Surface water network is very sparse in this region and there are no streams with a steady flow. Consequently, there is no any hydrological gauging station for the observation of surface water regime and resources in this region. Temporary surface runoff along the dry beds of this region mainly forms from summer rainfall, snow melting in spring and the amount of the runoff depends on the climate condition, land surface features and sources of runoff. Due to the heavy rainfall in summer period or intensive snow melting in spring periods, flash floods are may occurred along the dry beds from surrounding mountains. Such event may erode soil and cause land slide and consequently damage buildings and constructions.

Surface runoff distribution in this area defined by features of physic-geographical zones and altitudinal belts. Therefore, runoff distribution of the area can be presented by integral parameter as altitudinal dependence between specific discharge (M, l/sec km2) and average basin elevation (H, m) which reflecting physic-geographical conditions and slope aspects of the area. According to this relationship the study area belongs to the basins of dry beds with temporal runoff in the Gobi Desert of Asian Internal basin. According to this relationship the surface runoff in the study area varies from 0.02 to 0.05 l/sec sq.km

Mean value of the flash flood in Gobi steppe region can varies from 6 to 10 m^3/sec and this value is to be weak according to the flash flood classification. But heavy flash flood may occur along the dry bed with slope of 12-20^0 from the rainfall 100-25 mm.

Any assessment related to surface water issues should deal with environmental and flood damage aspects.

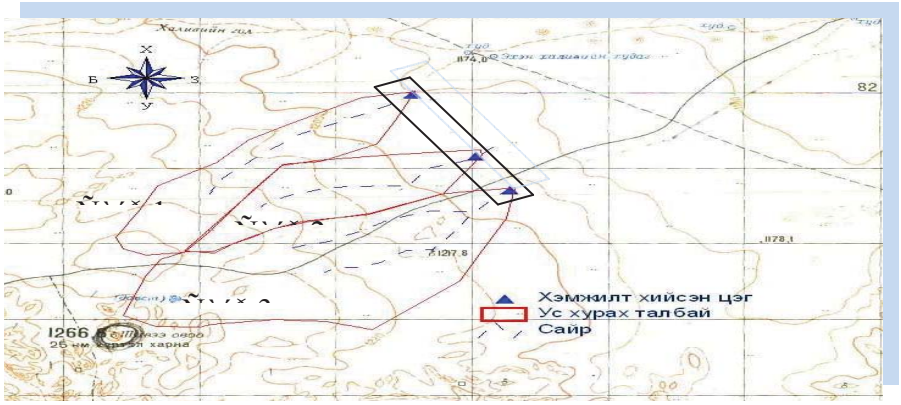


Fig. 2.10. The location of dry beds near the permanent airport

Surface condition of the area where planned to locate a new airport is even plain and there are three small dry beds with unclear channel formation are crossing the airport area. In rainy period may be form some surface ponds in small shallow depressions (Figure 2.10, 2.11). Elevation difference in the study area varies from 1180 to 1260 meters. Due to plain condition and unclear channel formation of dry beds, rainfall flow may cover wide area.

Fig. 2.11. The view of the unclear dry beds crossing the airport area

In terms of impacts of the expected new airport to the surface water, natural regime of the temporary runoff, soil infiltration and evapotranspiration are main issues. For example, building, paved air strip and roads may block the free passing of temporary runoff which occurs during the rainfall and snow melting and also isolating of infiltration and evaporation processes.

Some morphometric characteristics of dry beds crossing the new airport area are shown in Table 2.13

Estimation methods of runoff and flood discharge much depends on availability of existing data and there are number of methods and empirical formulae to estimate runoff.

In our case, we have selected one method for the estimation of flood discharge passing through the dry river beds in engaged sites: rainfall intensity method. Main data and input of the method are the amount of the rainfall and intensity, morphometric characteristics of the catchment area and runoff coefficient. This method is recommended for the small rivers and dry beds.

1. Method based on maximum intensity of rainfall

The State Construction Committee issued the Construction Norms and Regulation (CNR) document entitled "Norms and Regulation on Hydrological Methods and Estimation of their parameters (CNR 2.01.14-86)" in 1986 is recommended the following method. This method especially is adopted for Mongolian physio-geography and climate condition. The document is to be used for hydrological assessment.

This method is acceptable for small rivers with catchment area less than 200 km2 and is expressed by the following equation.

$$Q1\% = q`1\% * \varphi * H`1\% * \sigma * \lambda 1\% * F$$

Where: Q1% - maximum discharge with probability of occurrence of 1 %, m3/sec

q1% - specific discharge with probability of occurrence of 1%, l/sec. km2

φ - Runoff coefficient

H1% - daily maximum precipitation with probability of occurrence of 1 percent, mm

σ - Coefficient accounting regulation effect of lake, forest area, and marsh on flood regime

λ1% - Conversion coefficient from the peak discharge of probability of one percent of occurrence to other discharges with various probabilities of occurrences

F - Catchment area, km2

For estimating specific discharge with probability 1% , l/sec. km2 it is requires to estimate morphological coefficient (Φg) and travel time for over land runoff /t_{hs}/ by the following equations.

$$\Phi g = 1000\ L/Kg * J\hat{e}g * F1/4 * (\varphi * H1\%)1/4$$

Where: L - river length up to site, km
Kg - roughness coefficient for river bed and flood plain
Jg - mean slope of river bed and dry bed, %

The coefficient expressing the shape of overland (Φ_{hs}) is calculated by the following equation and this coefficient is involved for determination travel time for over land runoff /t_{hs}/.

$$\Phi_{hs} = (1000* l)1/2 / nhs *J1/4b *(\varphi*H1\%))1/2$$

$$l = F/1.8 (\sum l + L)$$

Where : L- mean length of catchment area, km
n_{hs} - overland roughness coefficient
J_b - mean basin slope
$\sum l$ - total length of dry beds in a catchment area, km

The runoff coefficients for rainfall flood can be calculated using the following formulae.

$$\varphi = C2 * \varphi o/(F+1)n6 * (Jb/50)n5$$

Where: C2 - coefficient expressing soil type
φo - F=10 km2 , runoff coefficient for case when Jb= 50
n6 - parameter expressing soil structure
n5 - coefficient expressing climatic condition
mean slope of downhill - Jhs

For estimation of maximum flow by this method it is required to estimate the daily maximum rainfall intensity with probability of occurrence of 1% .

Table 2.13. Some hydrological characteristics of the unnamed dry beds located near the study area

Name of the dry bed	location	L, km	F, km^2	J, ‰	Q1%, m^3/sec
Unnamed dry bed 1	43^O 09' 28.3" 106^O 50' 3.6"	4.26	5.68	7.04	**1.32**
Unnamed dry bed 2	43^O 08' 35.0" 106^O 50"43.6"	4.00	5.11	7.50	**0.63**
Unnamed dry bed 3	**43^O 08' 5.6" 106^O 51' 4.6"**	**3.80**	**12.52**	**7.89**	**3.30**

The runoff coefficient for dry beds in this region varies from 0.06-0.11 and it means about 90% of precipitation is lost. Average travel time of the above mentioned dry beds is 1.2-1.4 hours. Surface water regime and resources of the study area can be presented by the above mentioned indirect methods and information.

2.1.4 Hydrogeology

The project site is located in the footnote of the mesoscale mountains such as “Shivee Tolgoi”, “Bumbat khyar” hills with elevation of 1100-1200 m and directed from south-west to north east side (Figure 2.12).

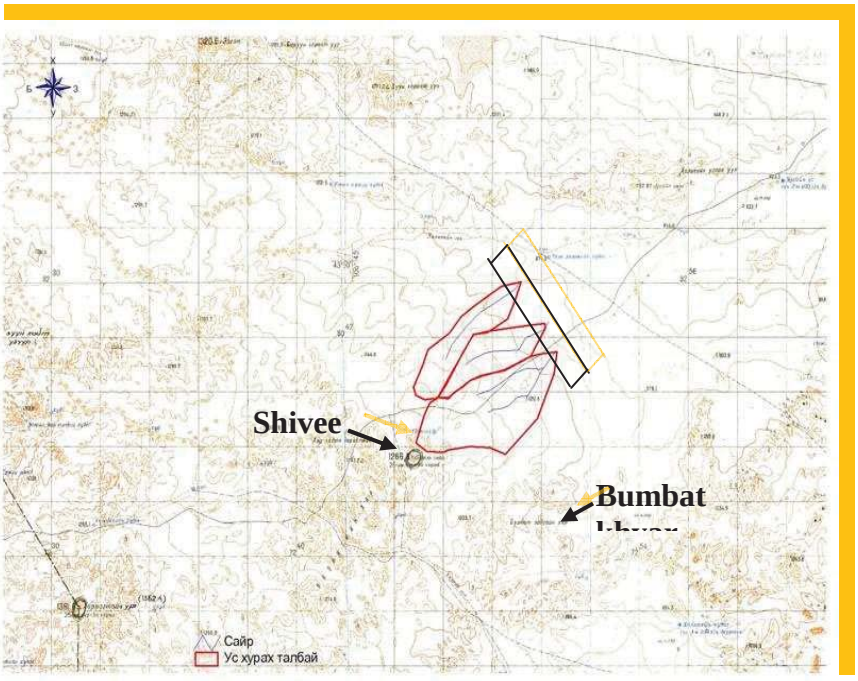


Figure 2.12 Location of the airport in relation to the surrounded hills as Shivee and Bumbat ovoo

The study site consists of intrusive, effusive and sedimentation deposits of Quaternary, Upper-Cretaceous and Paleozoic. Cenozoic and Paleozoic age rocks are seen in the highland surface outcrops and the project site is covered with a stratum layer of rocks of Mesozoic origin.

The hydrogeology of the site has been comprehensively studied. For example, the hydrogeological exploration survey conducted in 2003-2004 to identify water supply sources for “Oyu Tolgoi” and involved the area of “Gunii Khooloi”. Developed boreholes located in the NE corner of the site and 8 exploratory water supply boreholes drilled in 2005 are located in a chain along the eastern edge of the site. Additionally, there were a numerous network of boreholes have been drilled to establish the ore body for the mine.

In the “Bayan Shiree location a water horizon in the unconsolidated soils of Quaternary and Upper Cretaceous era” was identified, including a water complex of the Paleozoic age.

2.1.4.1 Aquifer of Quaternary deposits

The aquifer of the Quaternary age are widely spread throughout the site. The alluvial-proluvial and proluvial deposits consist of sand, gravel, loam and rock debris. The proluvial deposits are widely spread though in rather thinner, mainly dry, layers.

The alluvial and proluvial deposits contain high water storage and are expressed along major riverbeds. The "Khaliv Sair" is located in north from airport. There are tributaries of similar consistency coming down from the "Gurvan Gavil" hill range area to the dry "Khaliv Sair" riverbed remnant.

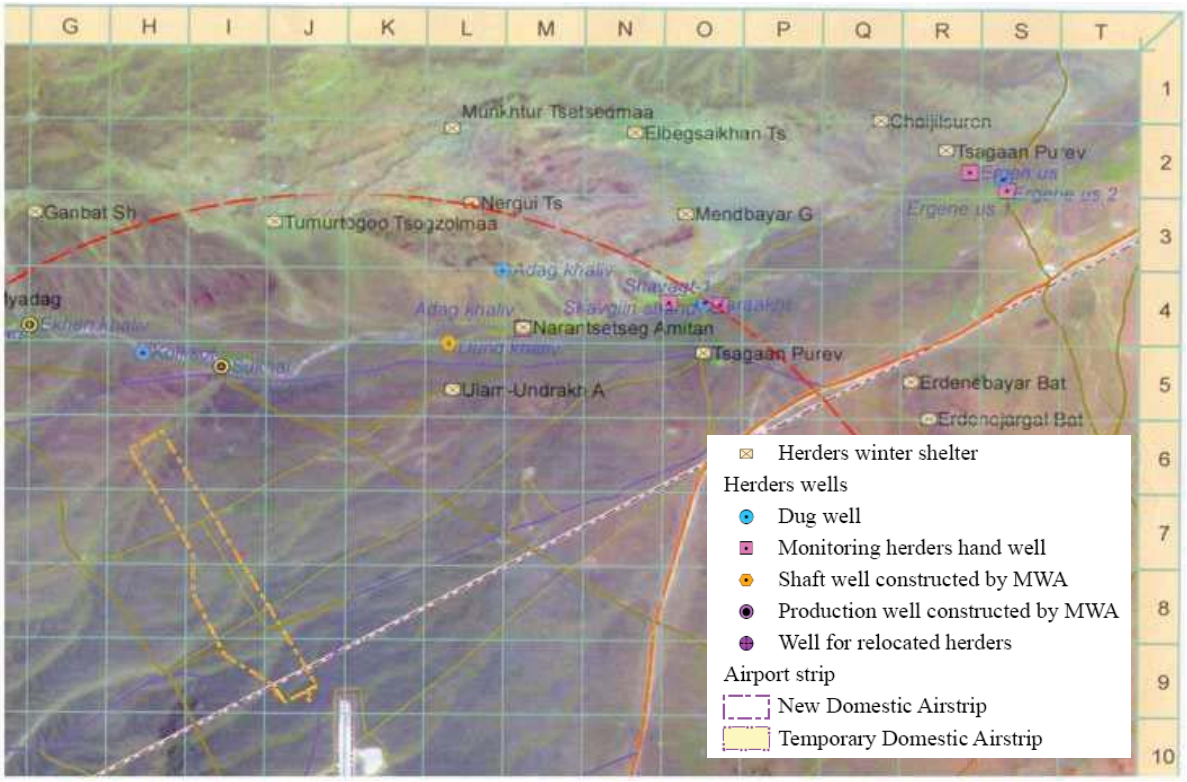


Figure. 2.13 Herders winter shelters and wells near the OT Permanent Airport (Prepared by Purevsuren.N. "Oyu Tolgoi" LLC)

The aquifers all along this drained riverbed are rich in water resources, with quite a number of functional wells. These shallow hand wells have a depth of 2.0-13.5 m. The water table is very close to the ground surface (2.0 - 2.82 m) and is the key potable water sources for local herders.(See Figure.2.13.) Specific yield of these wells exceeds 1 liter/sec. The Quaternary aquifers contain bicarbonate ions in abundance. The mineralization rate of water ranges between 0.24-0.49 g/l. The aquifers are mostly recharged by infiltration of precipitation. In the rainy, warmer season, temporary stream floods are frequent. This is followed by a sudden rise in the ground water level.

These wells are located in north from airport at distance 6-8 km. (See Figure 2.13)

According to the boreholes drilled in the study area of the Permanent Airport up to 25 m water was not detected (Soil Trade Co.,Ltd, 2010).

2.1.4.2 Aquifer in "Bayan Shiree deposit" of Upper Cretaceous

The "Bayan Shiree" unconsolidated deposit has reddish clay, light grey colored sand and thin layers of gravel.

The rate of water content of Cretaceous age layers varies greatly. Such a pattern may be explained with the fact that at the edge of the valley the water aquifers are separated by the presence of outcrops. Chemical analysis on borehole GH2x3 shows that it has 1.4g/ mineralization rate, pH – 8.5, hardness – 150 mg/l. If these criteria were correlated with the specific hydrogeological pattern of the area it may be expected that these criteria are typical.

2.1.4.3 Water complex of Paleozoic age

In the very SE corner of the valley of Permian granite rocks, Paleozoic effusive rocks are prevailing. At the northern edge of the "Khaliv Sair" they create numerous outcrops and are covered with Cretaceous age layers. There is no information concerning the hydrogeology of the site. In conformity with the data obtained during water survey works for the "Oyu Tolgoi" mine, the area should be classified as an area with relatively poor water content. It should be noted that with passing time the density of cracks in the bedrock shall increase and this will lead to an increase of its water filtration capacity.

In summary, it should be noted that based on existing hydrogeological conditions of the area, soil water shall not affected in the planned site for construction purposes.

2.2 Ecological resources

2.2.1 Fauna

The new airstrip area of 5.0 x 0.5 km^2, which is located 10 km northward from OT licensed area, is a very poor desert zone with limited vegetation and animal species. The local community uses this area for pasture purpose. During the survey we determined few reptile and amphibians species. But Oyu Tolgoi area can be temporary living places for birds and animals of passage. Especially number of animals increases in rainy years with good vegetation. Studies concerning fauna of the licensed area of the OT and surrounding area has been done by the "Eco-Trade" (Report documents of Environmental Impact Assessment of the Oyu Tolgoi Project. "Eco-Trade" LLC. 2006).

Endangered species

Of the mammals that occupy the territory of Umnugobi Province, 9 species are included in the Red Book of Mongolia (Ministry of Nature and Environment, 1997):

Salpinqotus Kozlovi - Pygmy jerboa;
Salpinqotus crassicaudata - Tick tailed pygmy jerboa;
Euchoreates naso - Long eared jerboa;
Felis silvestris - European wild cat;
Vormela peregusna - Marbled polecat;
Equus hemionus - Asiatic wild ass;
Gazella subgutturosa - Goitered gazelle;
Capra sibirica - Siberian ibex;
Ovis ammon - Wild mountain sheep;

Many of these species are under threat from illegal hunting and the longer term impact of overgrazing (Ministry of Nature and Environment, 1996). Measures are required to protect these species from extinction and recommendations have been proposed through the Biodiversity Action Plan for Mongolia (Ministry for Nature and Environment, 1996).

Of the 65 bird species recorded, the following species are included in the Convention for the International Trade of Endangered Species (CITES) animal protection schedule:

Milvus miqrans - Black Kite;
Buteo hemilasias - Upland Buzzard;
Aquila nipalensis - Steppe Eagle;
Gypaetus barbatus - Lammergeyer;
Neophron percnopterus - Egyptian Vulture;
Aeqypius nomachus - Cinereous Vulture;
Falco cherrug - Saker Falcon;
Falco pereqrinus - Peregrine Falcon;
Falco subutyo - Eurasian Hobby;
Falco tinnunculus - Common Kestrel;
Anthropoides virgo - Demoiselle Crane;
Otis tarda - Great Bustard;
Chlamydotis undulate - Houbara Bustard;
Bubo bubo - Eurasian Eagle Owl;
Athene noctua - Little Owl;

The birds *Chlamydotis undulate* (Houbara Bustard) and *Podoces hendersoni* (Mongolian Ground Jay) are listed in the Red Book of Mongolia (1997). Table 2.14 shows common bids that live and mainly occur in Oyu Tolgoi region.

Table 2.14. Birds of Oyu Tolgoi and Domestic Airstrip Area

#	Scientific name	Common name	Brief description
1.	*Buteo hemilasius*	Upland Buzzard	A migratory bird. Occupies the locality during mild winters with light snowfall. One of the few birds, which passes the summer nesting in the area
2.	*Aquila nipalensis*	Steppe Eagle	A migratory bird. They feed mainly on rodents and make nests in the steppe and at the base of the mountains
3.	*Neophron percnopterus*	Egyptian Vulture	A rare species which was casually noted only once in this area. This species feeds on carrion and carcasses of dead animals
4.	*Perdix daurica*	Daurian Partridge	This is a permanent species, which lives in steppes, ravines and cliffs. They are usually observed in flocks of 10 to 20, but at the start of April they commence mating in pairs. A female will lay between 10 to 15 eggs at one time. Considered a significant game bird
5.	*Syrrhaptes paradoxus*	Pallas Sand grouse	Permanent species, which nests in the territory of Khanbogd Soum. Feeds on breach grass and usually lays two eggs on the open sand or gravelly soil without any protective cover. Every day in the morning and evening they come to open water in pairs or in large numbers to drink. The hunters of Gobi provinces and Soums hunt this species of bird and export it as a medicine meat
6.	*Columba livia*	Rock Pigeon	Lives near people and buildings. A permanent species of Khanbogd Soum
7.	*Bubo bubo*	Eurasian Eagle Owl	They nest in cliffs, deep ravines and in large elms. Usually lays 2 to 4 eggs. Active at night. Feeds on rodents and small birds
8.	*Athene noctua*	Little Owl	More common than Bubo bubo in this area. Permanent species. Active in the evening and feeds on small rodents. Lays 3 to 4 eggs
9.	*Gaberida cristata*	Crested Lark	Permanent species that lives in sandy knolls and valleys. Builds its nest under bushes and lays up to 4 eggs at one time
10.	*Melanocorupha mongolica*	Mongolian Lark	A permanent species of lark commonly distributed in the steppes of Khanbogd Soum. They come in flocks to springs and to ice lakes to drink in winter
11.	*Eremophila alpestris*	Horned Lark	One of the most common permanent birds
12.	*Pica pica*	Black billed magpie	A permanent species. It builds its nest in cliffs and trees near the Khanbogd Soum
13.	*Pyrrhocorax pyrrhocorax*	Red billed Chough	Makes a permanent nest in buildings and structures, as well as in rocky places
14.	*Corvus corrax*	Common raven	Widely spread permanent species, which builds its nest on telephone poles, elms and Saxauls
15.	*Oenanthe oenanthe*	Northern wheatear	Builds its nest and lays eggs in a burrow. Lives on the steppes in an open environment of the mountain sides

#	Scientific name	Common name	Brief description
1.	*Buteo hemilasius*	Upland Buzzard	A migratory bird. Occupies the locality during mild winters with light snowfall. One of the few birds, which passes the summer nesting in the area
2.	*Aquila nipalensis*	Steppe Eagle	A migratory bird. They feed mainly on rodents and make nests in the steppe and at the base of the mountains
16.	*Passer montanus*	Eurasian tree sparrow	A permanent species, common in urban places, as well as in areas with shrubs and thickets
17.	*Passer domesticus*	House sparrow	Lives only near people and settlements

There are no reptile species found in the area that are listed as rare or protected through international convention. However, the snakes *Columber spinalis* and *Psammophis sp.* are generally considered to be rare.

2.2.2 Flora

New permanent airport for the Oyu Tolgoi project has been planned to be constructed in the north of the licensed area at 10 km located outside of the area, field survey of vegetation cover was carried out by Dr.Sanjid, from the Institute of Botany, Mongolian Academy of Science in September-October. Scientist Dr. Sanjid has involved in vegetation research survey in Oyu Tolgoi area as well as worked as expert in OSMT airstrip study.

Generally, the project site is located the Eastern Gobi desert steppe circle of the North Gobi desert district of the Eurasian great region according to the Mongolian botanical-geographical classification by A.A.Unatov, 1950; and H.Ulziikhutag, 1989. The Eastern Gobi desert steppe circle belongs to the desert steppe area and borders with the middle Khalkh circle in the north; the Eastern Mongolia steppe circle in the north-east and the Alashan Gobi desert circle in the south. (Figure 2.14)

Figure 2.14. The current condition of field for new airstrip

Vegetation study methodology

For vegetation species inventory is used data collected during 2010 autumn field survey. If found new species were checked through the Vegetation reference description book. For that purpose Key to the vascular plant of Mongoly by V.I.Grubov, 1982 and Ulziikhutag. Nadmid. Pasture and hay land vegetation species description, 1985 books have been used.

For vegetation survey we used area 25x25 м with size as sampling test site depending on vegetation coverage state. In each test site species composition, land color and state, slope, dominant species, soil surface have been described. Form to be filled consists of 2 components; vegetation general indicators and species detailed forms. Vegetation general indicators include vegetation community name in Latin or Mongol, coverage total /by dry grass, brush /, land color, vegetation aspect, number of species, summer condition, average height of grass, tone, recovered dominant species and also there coordinates , place name, surface, environment, animal impact, vegetation use, future imagine are described.

Species detailed study include species coverage, percentage, penology phases, height, number of stables, diameter, capability to growth.

2.2.2.1 Seed plants composition

Despite many other plants, there are very rare plants such as *Arneria guttata Bunge., Asterothamnus Novopokr* and *Potanina mongolica* which are listed in the Law on Flora. *Potanina mongolica* is icnludedin the Red Book of Mongolia. These rare and very rare plants grow in not only airstrip fields but also surrounding areas at certain level. List of seed plants giving in the Table 2.15.

Table 2.15. List of seed plants which grow in the area of new airstrip

Number			Name of species, types, families	In the license area of OT	In the airstrip area
family	type	species			
1			Poaceae		
	1	1	Aristida heymannii Rgl	Sp	Cop
	2	2	Achnatherum splendens (Trin) Nevsk	Sp	Sol
	3	3	Ptilagrostis Pelliotii (Danguy) Grub	Sol	Sol
	4	4	Stipa gobica Roshev	spl	Sp
	5	5	Enneapogon borealis Honda	Sp	Sp
	6	6	Cleistogenes soongorica Ohwi	Sol	Sp
	7	7	Eragrostis minor Host	Sp	Sp
2			Liliaceae		
	8	8	Allium polyrrhizum Turcz.ex Rgl	Cop	Cop
		9	A. mongolicum Rgl	Sol	Sp
	9	10	Asparagus gobicus Ivanov. ex Grub	Sol	Sol
3			Iridaceae		
	10	11	Iris oxypetala Bunge	Sol	Sol
		12	I.tennifolia Pall	Sol	Sol
4			Polygonaceae		
	11	13	Rheum nanum Sievers	Sol	Sol
5			Chenopodiaceae		

	12	14	Atriplex sibirica L	Sol	Sp
	13	15	Eurotia ceratoides C.A.Mey	Un	Sol
	14	16	Bassia dasyphylla Ktze	Cop	Cop
	15	17	Corispermum mongolicum Iljin	Cop	Sp
	16	18	Kalidium foliatum (Pall) Mey	Sp	Sp
	17	19	Suaeda corniculata (C.A.M) Bge	Sol	Sp
	18	20	Salsola passerina Bge	Sol	Cop
		21	S. collina Pall	Cop	Cop
		22	S. pestifera Nels	Cop	Cop
	19	23	Anabasis brevifolia C.A.Mey	Sp	Cop
	20	24	Halogeton glomeratus (M.B) C.A.Mey	Cop	Cop
	21	25	Micropeplis arachnoidea (Moq) Bge	Sp	Cop
	22	26	Sympegma regelii Bge	Cop	Sp
6			Cruciferea		
	23	27	Dontostemon senilis Maxim	Sol	Sol
	24	28	Potaninia mongolica Maxim	Sp	Sp
6			Fabaceae		
	25	29	Astragalus monophyllus Bge	Sol	Un
		30	A. vallestris R.Kom	Sol	Sol
		31	A. Junatovii Sancz	Un	Un
		32	A. grubovii Sancz	Un	Un
	26	33	Oxytropis aciphylla Lab	Sp	Sp
7			Gereniaceae		
	27	34	Erodium tibetanum Edgew	Sol	Sol
8			Zygophyllaceae		
	28	35	Peganum nigellastrum Bge	Sp	Sp
	29	36	Tribulus terrestris L	Sp	Sp
	30	37	Nitraria sibirica Pall	Cop	Sp
9			Tamaricaceae		
	31	38	Reaumuria soongorica (Pall) Maxim	Cop	Cop
	32	39	Limonium tenellum (Turcz) Ktze	Sol	Sol
10			Asclepiadaceae		
	33	40	Vincetoxicum sibiricum (L) Decne	Un	Un
11			Convolvulceae		
	34	41	Convolvulus ammanii Desr	Sol	Sol
12			Boraginaceae		
	35	42	Arnebia guttata Bge	Sp	Sp
	36	43	Lappula intermedia M.Pop	Sp	Sol
13			Labiatae		
	37	44	Panzeria lanata (M) Bge	Sol	Sol
	38	45	Lagochilus ilicifolius Bge	Sol	Sol
14			Plantagonoaceae		
	39	46	Plantago minuta Pall	Sol	Sol
15			Asteraceae		
	40	47	Heteropappus altaicus (Willd)	Sp	Sp
	41	48	Asterothamnus centrali-asiaticus Nov	Sol	Sol
	42	49	Ajania achilleoides (Turcz) Poljak	Sp	Sp
	43	50	Artemisia anethifolia Web et Stechn	Sol	Sp
	44	51	A. scoparia Waldst et Kit	Sp	Sp
	45	52	Echinops Gmelinii Turcz	Sol	Sp

	46	53	Scorzoneria pseudodivaricata Lipsch	Sol	Sol
		54	S. divaricata Turcz	Sol	Sol

Тэмдэглэгээ:
Cop - Элбэг, Sp - Нийтлэг, Sol - Ховор, Un - Нэн ховор

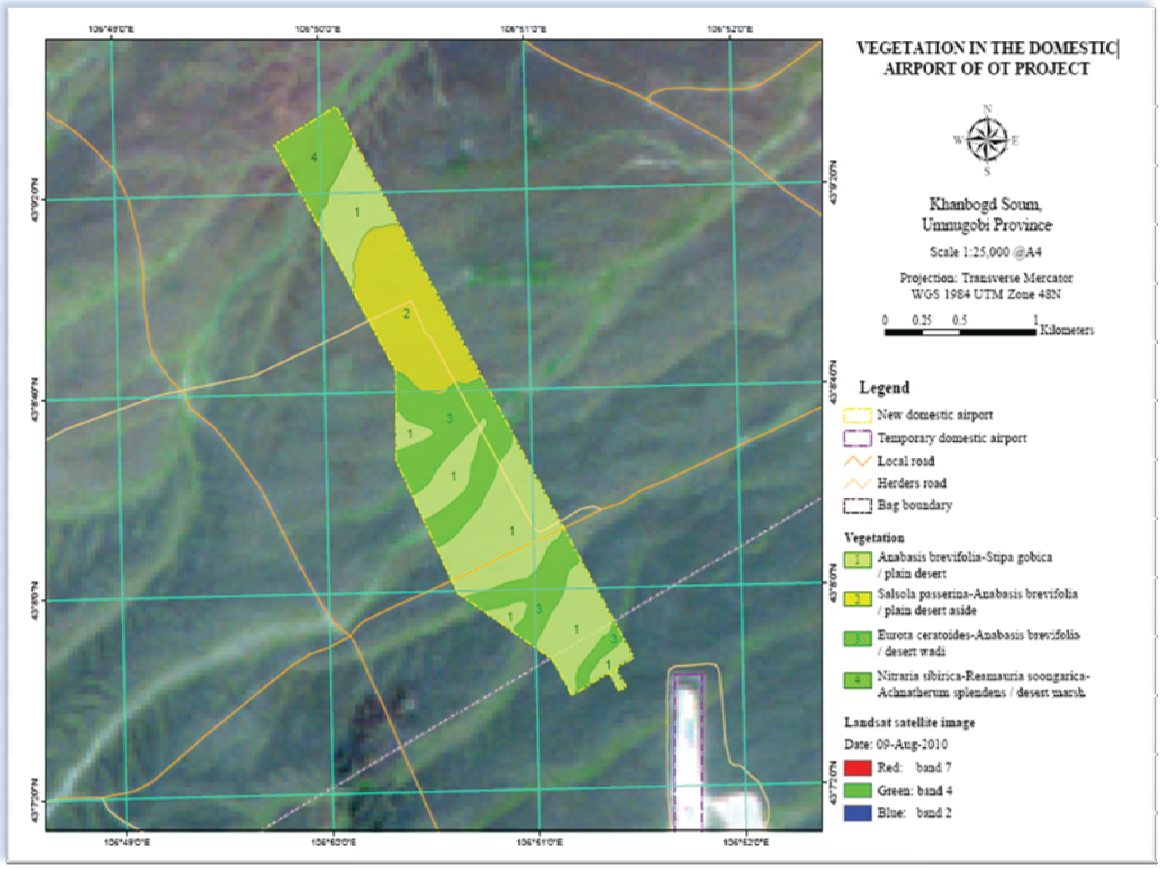


Figure 2.15 Vegetation map the new permanent airport site

2.2.2.2 Vegetation condition

In the area of planned airstrip, flora comprises of *Ananbasis sp., Salsola passerina., Ceratoides Gadnebin sp* and *Nitraria sp.* groups and vegetation cover can be divided into the steppe valley vegetation and meadow vegetation from hilly side. (Figure 2.15)

The steppe valley vegetation

The steppe valley is covered by gravel and vegetation cover is relatively bigger than stone covered black hills. Cover is about 5-10 % and gravel covered hillock were created. *Anabasis brevifolia* and *Stipa glareosa* are dominant and other plants such as *Salsola passerina, Convolvulus Ammanii, Dondostemon senilis* and *Arnebia guttata* exist an these hilly areas. In the hollow areas, there are *Anabasis brevifolia, Ceratoides Gadnebin, Salsola laricifolia, Convolvulus fruticosus, Sympegma Regelii, Oxytropus aciphylla, Ajania achilleoides, Reaumuria soongarica, Stipa glareosa, Cleistogenes soongarica, Dontostemon senilis, Astragalus sp.* and *Arnebia guttata*. In the hills vegetation cover was

estimated at 1-5 % and in the hollow areas 7-10 %. Ratio between hills and hollows are 3:7. Vegetation does not affect on surface color in hills and turns to bright yellow in hollow areas. Litter cover was 5-8 % due to annual plant *Aristida heymannii* grown in the last year.

Shrub cover was estimated at 6-7 % in hollow areas. Number of species was counted as 5 in the hillocks and 15 species in the hollow areas. These plants are fed by winter precipitation and autumn moisture.

The average height of plant is 2 cm in the hills due to dominant *Anabasis brevifolia* and 5-9 cm in the hollows. There are 2 layers in the hollows created by shrubs and grasses. In the hills any layer was not observed due to scattered vegetation. Currently there is no sinuses created. However in the last spring and summer, annuals and biannuals grew well and sinuses created well where litters accumulated and stored.

In the area, light brown soil of the desert is dominated. Surface of hills comprises of 5% of stones, 85 % of gravels, 4% of sand, and 1% of plants. If there are wells, it can be used for pasture of sheep and goat. Some dungs of antelopes and wild horses were observed, even few of them were seen in distance. There was less land disturbed by drilling and mining activities.

Dry River Bed meadow Vegetation

These areas are mostly covered with gravel, because of near ground water layer, silt layer soil, dominant groups of *Nitraria sp.* or *Achnatherum sp.* with one or two main plants. Vegetation cover is estimated at 7-10% which relatively higher than hills. The main characteristics of the ecotype is meadow group with 1 or 2 dominants. Despite *Nitraria sp.* and *Achnatherum sp,* other plants such as *Salsola passerina, Convolvulus ammanii, Lappula intermedia* and *Arnebia guttata* grow in these dry river bed areas. *Anabasis brevifolia, Sympegma Regelii, Oxytropus aciphylla, Ajania achilleoides, Reaumuria soongarica, Stipa glareosa, Cleistogenes soongarica, Dontostemon senilis* and, *Astragalus sp.* grow in spaces between dominant plants. Surface cover of *Nitraria sp.* and *Achnatherum sp.* is 5-10 % and 5-7 % in the hollows. Litter was quite abundant because it is kept very well by *Nitraria sp.* and *Achnatherum sp.* and annual plant growth in the last year.

In the hollow areas, there are *Ceratoides Gadnebin, Salsola laricifolia, Convolvulus fruticosus,* and *Arnebia guttata*. In the hills vegetation cover was estimated at 1-5 % and in the hollow areas 7-10 %. Ratio between hills and hollows are 3:7. Vegetation does not affect on surface color in hills and turns to bright yellow in hollow areas. Litter cover was 5-8 % due to annual plant *Aristida heymannii* grown in the last year. The total number of species was about 10. There was drought in summer of 2010. Grown plants are fed by sinter precipitation and autumn moist kept in soil. The average height of vegetation is 50-70 cm where *Nitraria sp.* and *Achnatherum sp* are dominant and 3-5 cm in hollows.

There are 2 layers created and higher layer was created by shrubs and *Achnatherum sp.* and lower layers were created by low shrubs and grasses. Currently there is no sinuses created.

In the area, light brown soil of the desert with silt cover is dominated. Surface of *Nitraria sp.* and *Achnatherum sp* comprises of 1% of stones, 5 % of gravels, 4% of sand, 80% clay and 10% of plants. Meadowy area of hills is used for pasture for sheep and goat. Some dungs of antelopes and wild horses were observed, and even few of them were seen in distance. There was less land disturbed by drilling and mining activities however, land degradation due to livestock grazing was observed.

2.2.3 Archaeology

The archeological research team of Institute of Archeology, Mongolian Academy of Science has conducted research work at the proposed airstrip in accordance with Mongolian Cultural Heritages Law. The research work was carried out in August 2010. There is no major archaeological artifacts occurred within the survey area (Appendix 2).

2.3 SOCIO-ECONOMICS

2.3.1 Population and main family income

Surrounding area of new airstrip location is used as pasture of local herder's family, for example during the autumn season 4-5 families stay around 2-3 wells located in north-east side of the air strip about 5-6 km. These wells are located about 5-6 km from the proposed airstrip and map the which shows location of mentioned wells provide by Environmental section of the OT.

Number of livestock may reach to several hundreds and mainly composed by camels. Table 2.16 shows population of Khanbogd and Bayan-ovoo soums. The population is nearly similar to any other soum of Mongolia, which is situated desert-steppe region and it is approximately 2650 in Khanbogd and 1560 in Bayan-Ovoo soum as respectively.

The population has increased by 600 and totally number is reached 3154 from 1999 to 2009 period.

Table 2.16. Population in neighboring soums of OyuTolgoi (Statistical Book of Mongolia, 2009)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Khanbogd Population	2256	2306	2401	2418	2451	2577	2659	2901	2974	3022	3154
Bayan-Ovoo population	1565	1563	1619	1612	1569	1551	1539	1520	1539	1502	1574

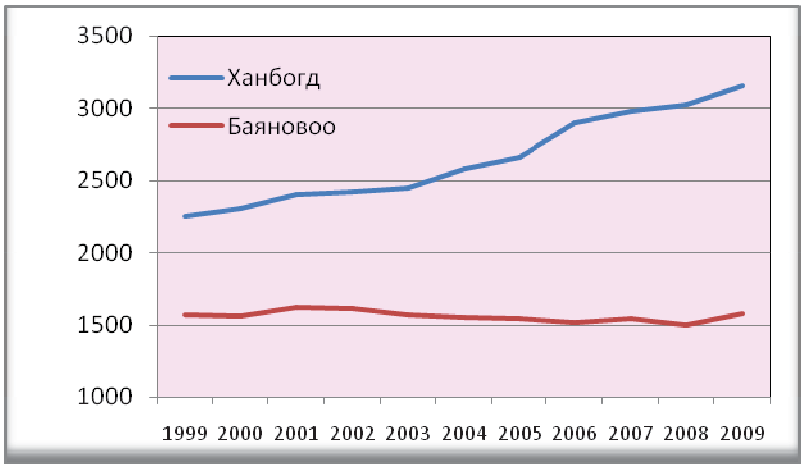


Figure 2.16. Growth of population neighboring soum of OyuTolgoi

In Figure 2.16, number of population has decreased in Bayan-Ovoo soum, however it has increased by approximately 75% in Khanbogd soum. It is shown that there is high increase of mechanical growth of population. In future, population will be anticipated to increase as continuously regarding the OyuTolgoi mining activity intensification and centralization of population in Khanbogd soum. Currently, 60% of total number of family is living in soum center and remaining 400 families farm animal husbandry as nomadic customs. Therefore, their main income is livestock. There are 100 000 livestock in Khanbogd soum and 90 000 in Bayan-Ovoo soum according to last 2 years statistics. Livestock is much dependent on weather condition; however, its number has increased recent years (2.17). Number of livestock is depicted Table 2.17 as each five kind of livestock.

Table 2.17. Number of livestock in Byayan-Ovoo and Khanbogd soum as shown each 5 kind of livestock, 1985-2009

a. Khangd soum

Year	Total	Camel	Horse	Caw	Sheep	Goat
1998	55832	13397	5080	4230	33125	20700
1999	86419	13677	5551	3915	34836	28440
2000	69300	13200	4500	1700	27000	23000
2001	47768	11417	2861	694	15686	17110
2002	52530	11513	2880	765	15851	21521
2003	55474	11257	2885	1313	16644	23375
2004	62306	12854	2891	1098	16996	28467
2005	69098	13567	3079	1311	18492	32649
2006	71285	13913	3181	1330	18830	34031
2007	86031	14430	3558	1564	22548	43931
2008	102456	15196	4151	1924	26436	54749
2009	116283	16364	4591	2281	30376	62671

б. Bayan-Ovoo soum

Year	Total	Camel	Horse	Caw	Sheep	Goat
1998	61273	4957	5601	2147	20368	28200
1999	69546	5100	6413	2534	22709	32790
2000	63000	4100	2500	1900	23500	31000
2001	46425	4087	3185	396	12892	25865
2002	46283	3968	2591	351	12124	27249
2003	54853	2265	2317	349	16197	33725
2004	51989	4016	2541	348	12446	32638
2005	58698	4140	2762	435	13688	37673
2006	64485	4157	3027	508	14904	41889
2007	77591	4317	3262	547	17325	52140
2008	93939	4469	3770	698	20652	64350
2009	91565	4610	3362	711	21357	61525

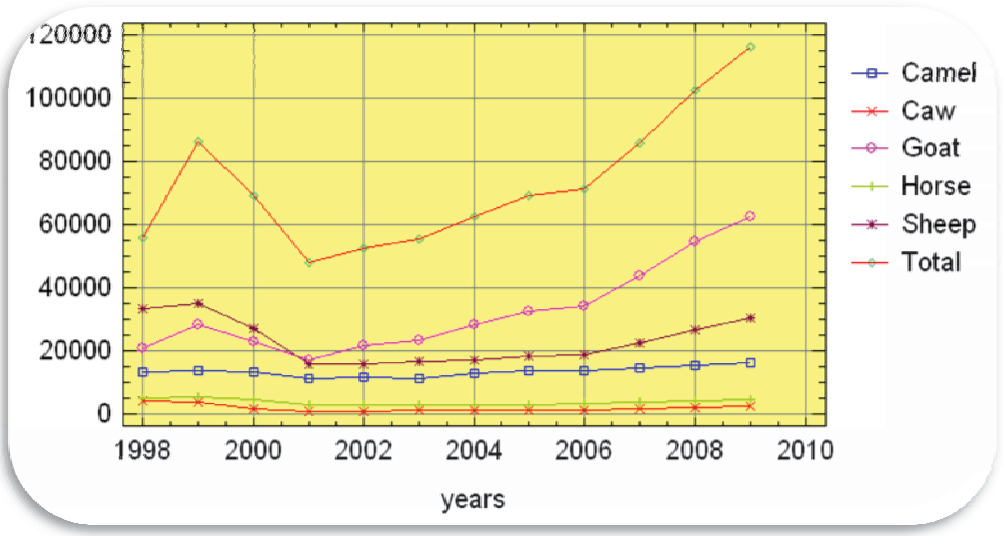


Figure 2.17. Number of livestock in Khanbogd soum

Main income of these soums (Byan-Ovoo, Khanbogd) comes from livestock product. Since middle of 1990, the price of goat cashmere is increased (1 kg cost is 20-30$), hence, cashmere became most important source of family income. Therefore, number of goat reached to 61525 amounts and placed 67% of the total number of livestock, however sheep and camel is not increased (Figure 2.17).

2.3.2 Employment

Mine management and administration functions will be centralized at the site. Off-site offices will be set up at Ulaanbaatar for government relations, at Dalanzadgad for hiring and regional government affairs, and at a major centre in China for procurement,

marketing, and other Chinese business matters. Initial staffing will include a combination of expatriates and Mongolians.

The number of expatriates will be relatively large at the beginning but will eventually be similar to levels at world-scale operations in developing countries run by Western companies. Expatriates will fill senior management roles. These individuals will be among the leaders in their fields of expertise and will have hands-on experience from other major mines. Other expatriate personnel with specific technical expertise will assist in training and in implementing operational procedures in the early years of the operation. Their goal will be to bring the Mongolian workforce to skill and knowledge levels that permit them to replace most of the initial expatriates.

OT LLC plans to establish significant training resources and facilities. OT LLC's objective is to maximize Mongolian employment levels and to have a 90% national workforce by the fifth year of operation.

The main transportation means for business activities is via airplane, because there is no highway or railway from Ulaanbaatar to Oyu Tolgoi.

3. ENVIRONMENTAL AND SOCIAL IMPACTS

During construction and operational phase of the proposed airstrip, the major negative environmental and potential impacts will be focused on near the airport and 3.2 km runway of the landing/takeoff.

Construction activities will be done including runway of landing/takeoff with 3250 m length, walking road, security line, control tower, passenger terminal and waiting hall, parking place, taking off/landing area signs, lighting, power, fence and surface water discharge channels.

Potential environmental impact anticipating as following:

- Soil erosion
- Vegetation degradation (impact leads change of environment of birds and mammals)
- Change of original land surface feature
- There is risk soil pollution due to spill of oil and combustible materials, and waste from near airport
- Air quality will be worsened during construction activities due to waste emission, dust and aerosols forming, noise, soil uncovering and road construction.

The short-term (temporary) impacts during construction phase as following:

- Increase of tracks traffic during transportation of construction material and equipment
- Increase of dust and aerosols due to construction work and soil uncovering.
- Potential impact of employers' health and social issue, who are working during construction phase for 8 months.

Main impacts are related to the increase of noise, traffic and induced development and the positive impacts of the closure and decommissioning of the Oyu Tolgoi Permanent Airport.

The environmental impact assessment methodology is matrix concept. Matrices have been developed and used in several options for impact assessment.

Tables 3.1 and 3.2 are shown the matrices of the potential impacts of the proposed new permanent airport. The potential impacts are divided into two parts:

1. **Construction Phase**
2. **Operational Phase**

These matrices provide cause-effective relationships between the various project activities and their impacts on the numerous environmental important aspects. This method divides environment condition into 4 parts as shown following:

- In I part, local environmental quality
- In II part, resource of ecology and biology (animals, vegetation etc)
- In III part, impacts of human activities (land use, road transportation, water and power supply etc)
- In IV part, impact to project economy, society, human health and historical and culture values.

3.1 Construction Phase

3.1.1 Physical Resource

3.1.1.1 Air Quality

In Oyu Tolgoi site, the dust phenomenon is occurred frequently due to eroded and bare soil. Particular, occurrence of dust is increased in spring season from March to June. The large silt content of the soils are dominant in this region, therefore, the dust could forms under relatively low wind speeds, and concentration of the dust and aerosols near building and downwind is comparable higher.

During the construction of the new airport, use of heavy tracks is main cause for soil degradation and forming of dust source. Especially during the spring season with dry soil and strong wind, dust spreads widely; polluting surrounding air, soil and vegetation cover affect negatively to the local herders and livestock.

3.1.1.2 Surface water

Surface water resources of new airport area at Oyu Tolgoi is estimated to be around the average value of this region ranging from 0.02 to 0.05 liter/sec per one sq.km
The maximum discharge of summer flood passing through a three small dry beds crossing the new airport squire is estimated by the rainfall intensity method which is acceptable for small rivers and dry beds with catchment area less than 200 km2 and maximum runoff passing through those dry beds varies from 0.70 m3/sec to 3.30 m3/sec

If the air strip and related structures can freely pass the temporary runoff and allow to water the pasture in the downstream side and accumulation of rainwater which can contribute to the groundwater recharge, then impacts to the surface water can be estimated less (Table 3.1).

The airstrips, buildings and roads will have blocking effect on surface runoff which form during the rainfall (summer) and snow melting (spring) floods, intercepting and isolating effect for the soil infiltration and evapotranspiration processes, thus interrupting the natural flow regime of surface runoff, infiltration and evapotranspiration. Therefore it is suggested to construct draining system for accumulating water which caused by blocking and isolating.

Misbalancing of microcirculation regime of surface water (to be delayed dispersed water, isolated soil infiltration, and evaporation) will cause on less changes on environmental soil moisture and vegetable cover.

It is needed to build the flood protection structures as dam or diverting channels against possible summer and spring floods around the new airport.

3.1.1.3 Ground water

Results of the hydrogeological brief description near the proposed structure area shows that soil water is not exposed in the depth of 25m in the working area where planning to build the airport strip . So, we can make a conclusion that there is a less impact to the ground water. (Table 3.1, 3.2)

Existing wells used by herders would not affected by airport construction (Figure 2.13).

3.1.1.4 Topography and soils

Construction activities have a potential to exacerbate erosion in an area where soils are naturally prone to erode particularly if summer rainfall is high following dry spring periods. In addition, the development of the airport site will result in an increase in run-off due to the construction of impervious surfaces.

Potential impacts from soil erosion, which could impact the preserved biological resources and the instability of the terrain that could cause portions of soil to towards the surrounding airstrip region during strong rainy events and therefore affect components of the OT Permanent Airport infrastructure. These impacts are expecting to be long time during construction phase of the airport, however, its quantity will be relative low (Table 3.1).

Dust deposition is depending on size of particles, wind velocity, soil condition, atmospheric instability and environmental impacts associated with construction phase activities.

The dust deposition impacts in site of permanent airport at Oyu Tolgoi were used the ISC long-term dispersion model. The area source dry deposition calculations for the ISCLT (Industrial Source Complex Long Term, USA) model are based on the numerical integration algorithm for modeling area sources. The ISC long-term model uses meteorological data that have been summarized into joint frequencies of occurrence for particular wind speed classes, wind direction sectors, and stability categories. The ISCLT

model uses a Gaussian plume equation to be calculating dust deposition. Emission rate of the dust is expressed as the following equation.

$$P=S\ W_c\ \gamma$$

Where: P is dust emission rate, S- is area in study m^2, W_c is specific dust flow mg/m2·sec, γ is soil erosion coefficient. In our case dust emission has been estimated and chosen as below according to concrete method. P=(3923 x323) m^2 x 0.1 $x10^{-6}$ mg/m^2·sec x 0.1 = 0.0126 mg/m^2 (The methodological handbook on estimation of polluting substances released into atmosphere by different industries, 1986. c.103. in Russian)

Region of the source is divided into several sectors depending on seasonal and annual wind frequency of direction and speed. Dust concentration is calculated each receptor points in model coordinate system and integrated.

ISCLT uses hourly and seasonal meteorological data and we have used Khanbogd Meteorological Station data from 2000 to 2009. Model coordinate system is Universal Transfer Mercator system, UTM.

Methodology of dust deposition.

The deposition flux, F_d, is calculated as the product of the concentration, χ_d, and a deposition velocity, v_d, computed at a reference height z_d:

$$F_d = \chi_d \bullet v_d \qquad (8)$$

The calculation of deposition velocities is described below.

A resistance method is used to calculate the deposition velocity, v_d. The general approach used in the resistance methods for estimating v_d is to include explicit parameterizations of the effects of Brownian motion, inertial impaction, and gravitational settling.

$$v_d = \frac{1}{r_a + r_d + r_a r_d v_g} + v_g \qquad (9)$$

Where, v_d = the deposition velocity (cm/s),
v_g = the gravitational settling velocity (cm/s),
r_a = the aerodynamic resistance (s/cm), and,
r_d = the deposition layer resistance (s/cm).

Note that for large settling velocities, the deposition velocity approaches the settling velocity ($v_d \rightarrow v_g$), whereas, for small settling velocities, v_d tends to be dominated by the r_a and r_d resistance terms.

In addition to the mass mean diameters (microns), particle densities (gm/cm^3), and the mass fractions for each particle size category being modeled, the dry deposition model also requires surface roughness length (cm), friction velocity (m/s), and Monin-Obukhov length (m).
The atmospheric resistance formulation is based on Byun and Dennis (1995):

stable (L > 0):

$$r_a = \frac{1}{k\, u_*}\left[\ln\left(\frac{z_d}{z_o}\right) + 4.7\ \frac{z}{L}\right]$$

unstable (L < 0):

$$r_a = \frac{1}{k\, u_*}\left[\ln\frac{(\sqrt{1+16\,(z/|L|)}\,-1)\,(\sqrt{1+16\,(z_0/|L|)}\,+1)}{(\sqrt{1+16\,(z/|L|)}\,+1)\,(\sqrt{1+16\,(z_0/|L|)}\,-1)}\right]$$

Where, u_* = the surface friction velocity (cm/s),
k = the von Karman constant (0.4),
z = the height above ground (m),
L = the Monin-Obukhov length (m),
z_d = deposition reference height (m), and
z_o = the surface roughness length (m).

The coefficients used in the atmospheric resistance formulation are those suggested by Dyer (1974). A minimum value for L of 1.0m is used for rural locations.

The approach used by Pleim et al. (1984) to parameterize the deposition layer resistance terms is modified to include Slinn's (1982) estimate for the inertial impaction term. The resulting deposition layer resistance is:

$$r_d = \frac{1}{\left(Sc^{-2/3} + 10^{-3/St}\right) u_*} \qquad (10)$$

Where, Sc = the Schmidt number ($Sc = \upsilon/D_B$) (dimensionless),
υ = the viscosity of air (_ 0.15 cm^2/s),
D_B = the Brownian diffusivity (cm^2/s) of the pollutant in air,
St = the Stokes number [$St = (v_g/g)(u_*^2/\upsilon)$] (dimensionless),
g = the acceleration due to gravity (981 cm/s^2),

The gravitational settling velocity, v_g (cm/s), is calculated as:

$$v_g = \frac{(\rho - \rho_{AIR})\, g\, d_p^2\, c_2}{18\mu}\, S_{CF} \qquad (11)$$

Where, ρ = the particle density (g/cm^3),

ρ_{AIR} = the air density (_ 1.2 x 10^{-3} g/cm^3),
d_p = the particle diameter (μm),
μ = the absolute viscosity of air (_ 1.81 x 10^{-4} g/cm/s),
c_2 = air units conversion constant (1 x 10^{-8} $cm^2/\mu m^2$), and
S_{CF} = the slip correction factor, which is computed as:

$$S_{CF} = 1. + \frac{2 x_2 \left(a_1 + a_2 e^{-\left(a_3 d_p / x_2\right)}\right)}{10^{-4} d_p} \qquad (12)$$

and, x_2, a_1, a_2, a_3 are constants with values of 6.5 x 10^{-6}, 1.257, 0.4, and 0.55 x 10^{-4}, respectively.

The Brownian diffusivity of the pollutant (in cm/s) is computed from the following relationship:

$$D_B = 8.09 \times 10^{-10} \left[\frac{T_a S_{CF}}{d_p}\right] \qquad (13)$$

Where T_a is the air temperature (°K).

The first term of Eqn. (13), involving the Schmidt number, parameterizes the effects of Brownian motion. This term controls the deposition rate for small particles. The second term, involving the Stokes number, is a measure of the importance of inertial impaction, which tends to dominate for intermediate sized particles in the 2-20 μm diameter size range.
For area source emissions, Equation is to the form:

$$F_{dn} = \chi_{dn} \bullet v_{dn} \qquad (14)$$

$$\chi = \frac{Q_{A\tau} K \phi_n v_{dn}}{2 \pi u_s} \int_x \frac{V_{dn} D}{\sigma_y \sigma_z} \left(\int_y \exp \left[-0.5 \left(\frac{y}{\sigma_y} \right)^2 \right] dy \right) dx$$

The parameter $Q_{A\tau}$ is the total mass per unit area emitted over the time period τ for which deposition is calculated.

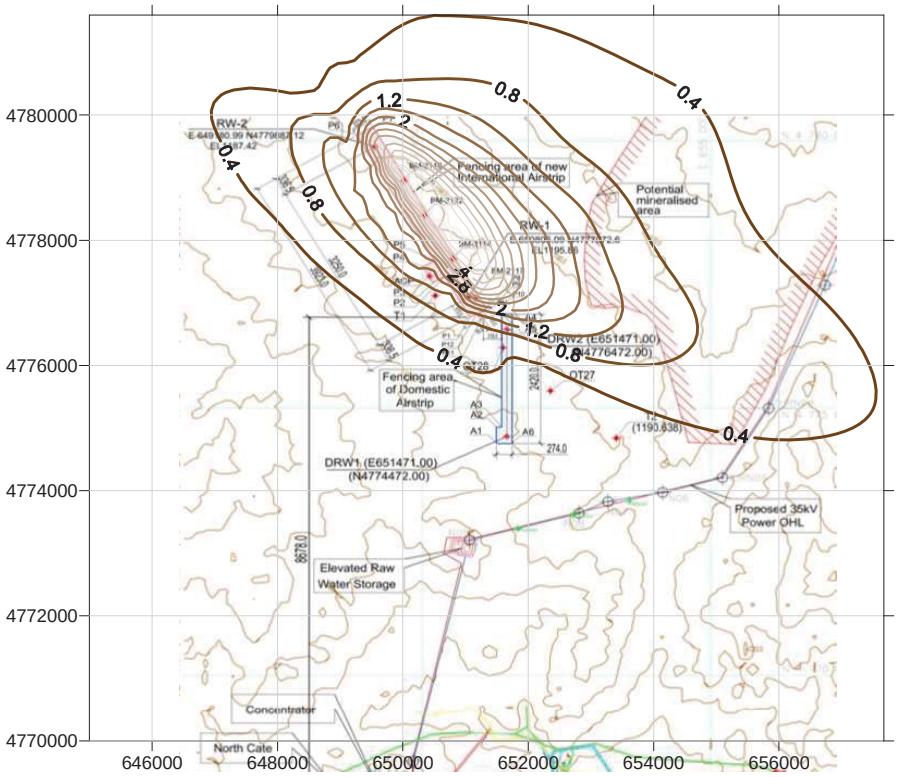


Figure 3.1. The spring total deposition values in the airstrip dust sources simulated by long-term deposition model (g/m^2)

The dust deposition is calculated in spring and summer season as considered that runway as area source with geometer size (length 3km, width 323m). All receptor points are covered by 13000x12000m^2 squares and distance between 2 receptors are 325-400m. Here, dust diameter is chosen less than 100µm and density is approximately 1.1 g/cm3

Figure 3.1 and 3.2 are shown dust deposition amount at runway of landing/takeoff in spring and summer, and their value varies approximately 1.0-5.0g/m2. Eastward of source, the deposition value is less than 0.4g/m2 and distributed nearly 1000m in summer and 6000m in spring along the dominant downwind. However, the dust deposition is relatively higher during construction phase. Therefore, maximum value of the deposition is expecting to detect near new permanent airport during the construction activities. This activities will be done only construction phase of the airport, however, it is might be main reason for degradation of vegetation cover.

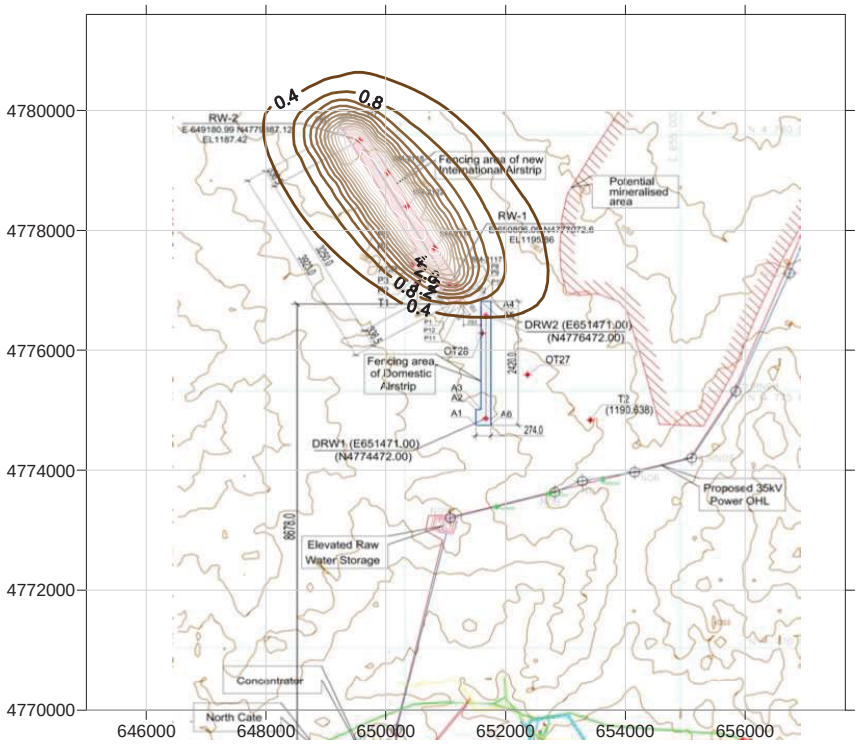


Figure 3.2. The summer total deposition values in the airstrip sources simulated by long-term deposition model (g/m^2)

3.1.1.5 Noise

In field survey, noise level was 40.2 dBz, same time wind speed is 12 m/s. On-site construction activities are unlikely to pose a significant off-site noise impact, as the site is quite isolated and away from developed urban areas and the type of construction do not generate high noise levels. However, although transient in nature, the noise associated with heavy equipment traffic moving on and off the site and construction of the 10.0 km connector road is likely to be of greatest impact to the surrounding community (Table 3.1 and 3.2).

3.1.2 Ecological Resources

3.1.2.1 Flora

There will be direct losses of vegetation caused by excavation, fill and site development from the new airstrip area. The remaining vegetation will be affected by dust-deposition during construction (Table 3.1 and 3.2).

Total cost of pasture to be destroyed with size 130 hectare and average yield 300 kg /hectare would be **2775.0** thous.tug considering 100 kg pasture yield cost is 5500 tug according to methodology issued from MNET in 2010.

3.1.2.2 Fauna

Noise and dust generation due to the construction of the access roads will frighten away animals. 62 bird species have been recorded in the Oyu Tolgoi Project Area, with a great number of these species having low densities and a wide habitat range. Many of the more common bird species found in the area are unlikely to be strongly affected by the airport construction. It is anticipated that the overall construction related impacts on the fauna will be minimal. (Table 3.1 and 3.2)

3.1.3 Human Use Values

3.1.3.1 Land use patterns

The new permanent airport construction work will affect area with size 130 hectare, length 4000 m and width 323m, changing vegetation coverage to paved surface releasing from pasture use. (Table 3.1, 3.2).

In order to prevent and reduce soil and land destroying, strip and buffer area for fence should be protected.

Height of strip area ranges between 1187.4-1195.8 m, most of area(strip building) has height 1190-1195 m. According to the soil survey topsoil stripped with depth 0-30 sm should be stored by covering to reuse for land rehabilitation after construction work completed. Except strips terminals, building for passengers, customer's control, air navigations, water drainage and others will be built up. During construction phase ground work will be done. Therefore after construction work end, land rehabilitation, recovering and green planting work should be performed.

The vegetation and coverage will be affected by dust increased from vehicle and heavy mechanism movement and sourced from small particle sized soil from dry surface due to more frequent occurring dust storm and strong wind which are typical in Gobi desert area.

Therefore in reduce soil blowing should increase green area by plant trees and shrubs such as elm, saxaul, oleaster, poplar and vegetations as longstalk peach, caragana; and nitraria, larschleaf, anabasis originated from Gobi area and adapted to dry sharp climate condition.

According to the project plan filling materials to be used for airstrip construction will be extracted from existing quarries. OT is asked to conduct biological rehabilitation according to the Mongolian standards as mentioned in the Concrete solution stone's exploring project's environmental impact detailed assessment report performed by Conditsi Co.,Ltd, 2008.

It is planned to extract, smash and transport from quarry, which is used during construction of old domestic airport. According to plan of the project land with depth 1 m will be dug, 139000 m^3 area will be filled.

Total cost of soil, where 0.2% of total is humus (Table 2.12) would be **7672.8** thous.tug considering 1 kg humus is estimated 276 tug according to methodology issued from MNET in 2010.

3.1.3.2 .Transportation

Heavy machine and ground equipment traffic will be mainly impacted to the soil erosion during construction of permanent domestic airport, road and their building activities. The dust in the ambient air would influence as long time interval to the surrounding area of the airport. Hence, to be less dust pollution in atmosphere, it is should be focused on

arrangement of scheduled to work in the morning and evening calm condition, has to build auto-parking and do not use line branches of the road.

It is possible to arrange that heavy track and machine could temporarily leave in the place where to be built an airport under controlling of watchman, to carry employers to the camp in the morning and evening and lunch is delivered to the construction area.

To build permanent airport and road from Khanbogd soum to the northward with 5.2 km length, are likely very benefit to the around of Oyu Tolgoi permanent flight services.

3.1.3.3 Water supply

During the construction phase of the airstrip, necessary technical water will be supplied from existing Oyu Tolgoi borewells. As planned for that purpose 200 ton water per a day, in total 42000 tone water will be consumed.
Specialized conclusion about the quality and amount of water used for domestic and commercial purpose was done by Water Authority of Implementing Agency of Mongolian Government and official document with number 3A/156, mentioned that water treated by the treatment plant of Oyu Tolgoi meets the main requirements of MNS 4943 2000 state standard and can be used for the drilling technology and for the road dust, have been received by Oyu Tolgoi Co., Ltd on 05.June,2007. Therefore, for technical purpose (cement and its mud etc), treated water is needed to reuse.

It is required to store water in reservoirs such as tank under considering 1000 liter per day, sewage from used water is needed to keep in special borehole and it is transported to Oyu Tolgoi main sewage point by specialized car every 3 days. In further underground water wells in airport near area will be investigated and exploited.

3.1.3.4 Power usage

Use of electro energy is not highly required during airstrip construction of the airport. However, power generator and light line will be built.

Power generator installation is one of part of to build airport and its construction activities are affected to soil as long (Table 3.1 and 3.2).

It is needed to use solid waste into road buildings due to ground work of the power generator installation and to be preventing soils from the fuels spilling during pour off is covered by solid protection.

3.1.4 Quality of Life Values

3.1.4.1 Socio-economic

Temporary working place will be formed during the airport construction and employers have to select from local people as benefiting for their local economy and society.

3.1.4.2 Public health

Oyu Tolgoi is located in very dry desert and semi desert region as before mentioned. Therefore, it is needed to prevent from dust to be safe human health and in case of without any accident during the airstrip construction of the airport.

3.1.4.3 Cultural, historic and archaeological aspects

The archeological research team of Institute of Archeology, Mongolian Academy of Science has conducted research work at the proposed airstrip in accordance with Mongolian Cultural Heritages Law. The research work was carried out in August 2010 (Annex 2).

However, if historical or archaeological artifacts are found during the airstrip construction, according to the should stop work and inform the local administration of Khanbogd soum, police department and related research organization and operate as stated in the OT's Cultural Heritage Chance Find Procedures".

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3.2 Operation Phase

3.2.1 Physical Resource

3.2.1.1 Air Quality

Impacts to ambient air quality were assessed considering the following principal 4 sources: aircraft and ground support equipment; road vehicle emissions, and several stationary sources. Among them, aircraft and vehicular traffic are the main sources of air pollutant emissions.

It is clear that the emissions of certain air pollutants such as carbon monoxide (CO), hydrocarbon (CH), nitrogen oxides (NO2) and particulate matters in the study area will be increased during implementation of the new domestic permanent airport.

On commissioning of the new airport, the frequency of flights will be 1 flight per every day within week. According to OT Mine Construction project, the airport activities will be extended and it is anticipated that airport will become as International Airport.

During the period between landing and takeoff, some activities are going on within aircraft and around airport such as transporting of passengers, cargo, luggage, etc as well as refueling, sanitation and catering services are also performed. This time spending will account for approximately one 1-2 hours per day. The emission associated with these activities is low and pollutant is not much expecting as well (Table 3.1 and 3.2).

3.2.1.2 Noise

The operation of the Oyu Tolgoi Airport will increase noise levels in the predominantly rural area. The increased levels of noise will be generated mainly from aircraft landing and take-off. (Table 3.1)

Sound from a small localized source (approximating a "point" source) radiates uniformly outward as it travels away from the source in a spherical pattern. The sound level attenuates or drops-off at a rate of 6 dBA for each doubling of the distance (6 dBA/DD). This decrease, due to the geometric spreading of the energy over an ever increasing area, is referred to as the *inverse square law*.

For example, Figure 3.3 shows that since the same amount of energy passes through both squares, the energy per unit area at 2D is reduced 4 times from that at distance D. Thus, for a point source the energy per unit area is inversely proportional to the square of the distance. Thus taking 10 log10 (1/4) results in a 6 dBA reduction (for each doubling of distance). This is the point source attenuation rate for geometric spreading.

Based on the inverse square law the change in noise level between any two distances due to the spherical spreading can be found from:

$$dBA_2 = dBA_1 + 10\log_{10}[(D_1/D_2)]^2 = dBA_1 + 20\log_{10}(D_1/D_2) \qquad (15)$$

Where: dBA_1 is the noise level at distance D_1, and dBA_2 is the noise level at distance D_2.

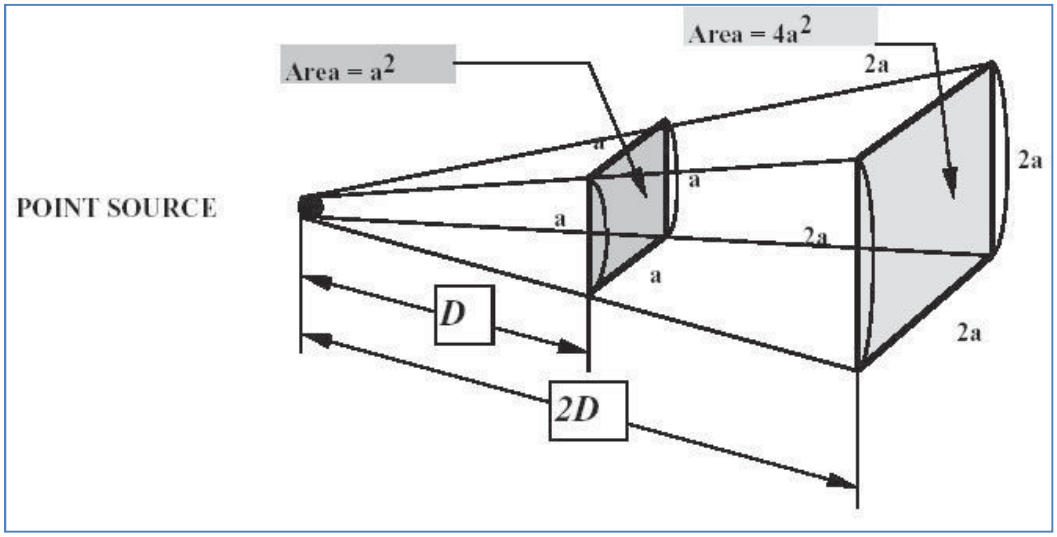

Figure 3.3. Point Source Propagation (Spherical Spreading)

However, aircraft traffic noise at the airstrip within certain time interval is not a single, stationary point source of sound. The movement of the aircraft makes the source of the sound appear to emanate from a line (line source) rather than a point when viewed over some time interval (see Figure 3.4). This results in cylindrical spreading rather than the spherical spreading of a point source.

Since the change in surface area of cylinder only increases by two times for each doubling of the radius instead of the four times associated with spheres, the change in sound level is 3 dBA per doubling of distance. The change in noise levels for a line source at any two different distances due to the cylindrical spreading becomes:

$$dBA_2 = dBA_1 + 10\log_{10}(D_1/D_2)$$

Where: dBA_1 is the noise level at distance D_1, dBA_2 is the noise level at distance D_2

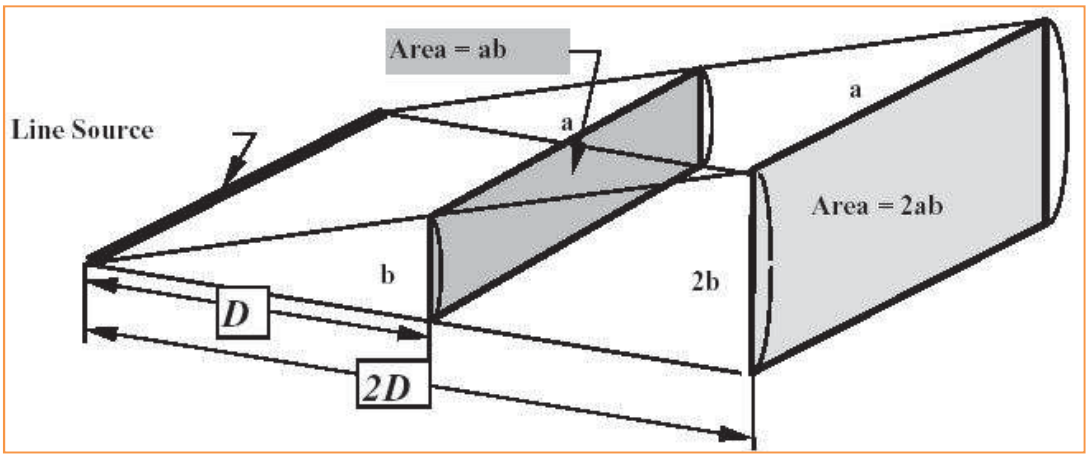

Figure 3.4. Line Source Propagation (Cylindrical Spreading)

Result and discussion. According to the engineering plan of the Oyu Tolgoi proposed airstrip relocation, the total length of the airstrip is approximately 3250 m. It has been considered that aircraft use approximately 1500 m of total airstrip length during landing and takeoff. Therefore, airstrip assumed as line source of the noise with 1500 m length and 200 km/h speed. A barrier is not included in our study because the area surrounding the relocation area is open and the surface is flat and homogeneous.

Spatial distribution of the noise level is done based on the estimation that the study area is 4000 m x 3500 m with the airstrip located in the centre and calculated using 40 receptors, and its value varies between 40-83 dB (Figure 3.5).

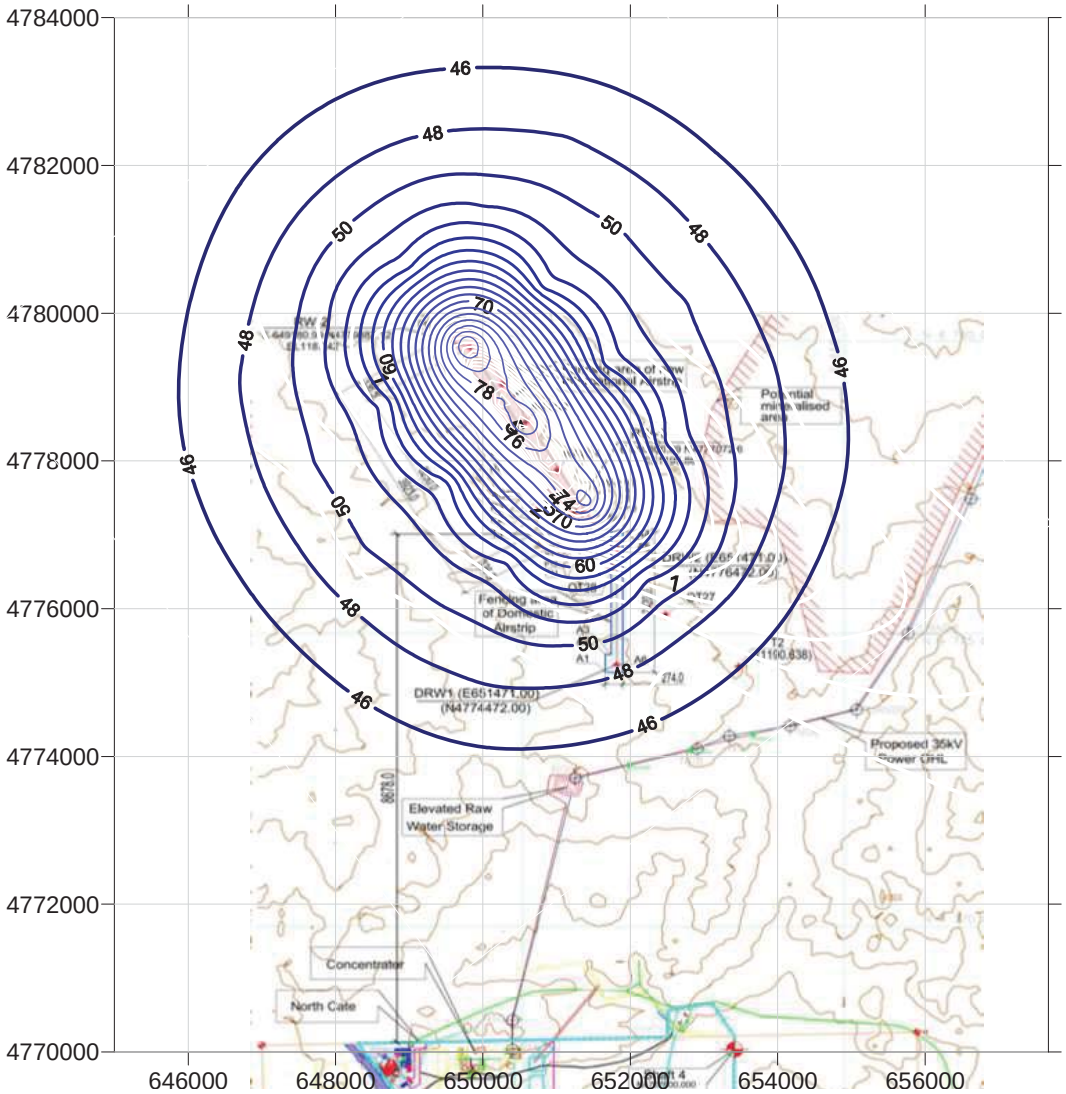

Figure 3.5. Spatial distribution of the noise level from Oyu Tolgoi Permanent airstrip

Noise modeling was conducted for the 3 km road and new control tower and terminal building for the operation phases based on 1-hour daytime predicted noise contours for daytime (09:00 – 10:00) indicated 45 dB(A).

The Mongolian standards establish a maximum environmental noise exposure for nearby residents as 60 decibels (MNS 4585:2007) (dBA).

In July 2000, the Federal Aviation Administration published a draft update of the 1976 policy. The proposed policy "reaffirms and incorporates the major tenets" of the 1976 policy. The policy continues to define areas of "significant noise exposure" as locations where noise levels are DNL 65 dB or higher (Establishing Airport Noise Compatibility Polices. Chapter 7. 2002)

U.S. Environmental Protection Agency (EPA) – A report published in 1974 by the EPA Office of Noise Abatement and Control continues to be a source of useful background information. Using Yearly Day-Night Average Sound Level (DNL) as a measure of noise acceptability, the document states that "undue interference with activity and annoyance" will not occur if outdoor noise levels in residential areas are below DNL 55 dB and indoor levels are below DNL 45 dB. These thresholds include an "adequate margin of safety" as the document title indicates.

Aircraft Noise can be measured day-night average noise level, where night-time noise is weighted to account for increased annoyance associated with noise during the night. According to research, all land uses are considered compatible noise levels less than 65 dB(A).

According to measurement of field survey, maximum noise level of Fokker type aircraft is 72.9 dB (http://www.faa.gov/about/office_org/headquarters_offices/aep/noise_levels/) and it is 80 dBA for Boing series aircraft. If we assume Boing series aircraft will land at OT new domestic airport, noise level will increase by 8 dBA or 11% compare to previous noise level. Therefore, increase of noise level is than 17% (Area Equivalent Method Version 7.0 User's Guide January 2008), it is not needed to do detailed research study.

As stated above the frequency of flights to the airport OT will be 1 time per day and noise level potentially is expected be low impact.

3.2.1.3 Topography and soils

When start operation of airport, long term impact is shown due to new human activities regarding airport service. Potential impacts are following:

- ✓ Soil erosion due to increasing of mobile traffic
- ✓ Soil pollution from liquid waste and spill in near airport
- ✓ Impact of dust from eroded soil due to wind to the vegetation cover
- ✓ It is possible to pollute air and soil in surrounding of the airport due to airplane, mobile and power generator emission of NO_2, SO_2, other gases, heavy metal (Pb) and oil production.

Therefore, to be protecting from soil erosion and pollution, it is needed to carry out some activities as permanently. For example, it is needed to carry out soil pollution monitoring.

3.2.1.4 Water resources

No surface water formations, such as streams with permanent flow, exist within the proposed airport site and only dry beds which could have runoff during the heavy rainfall events. Therefore the impact on surface water is relatively low.

Water is not exposed in the 15 boreholes drilled along strip with depth of 6.0-6.4 m. Soil water also is not exposed in the boreholes drilled near the study area with depth up to 15.0-25m (Soil Trade Co.,Ltd, 2010).

Gobi and steppe areas, which are typical in the project region, have a mean specific runoff of flash flood of 6-10 l/sec km^2 and the maximum intensity of the flash flood is reached when the hill slope is 12-20^o and maximum daily rainfall amount 43 mm (August 18, 1981. Khanbogd). It is suggested, therefore, to construct a drainage system to manage the accumulation of water caused by blocking and isolating.
Flight strip and other building construction destroy the natural regime of evaporation and infiltration process of rainwater to be flown to the flight squire in rainy period and It is necessary to make regular control and maintenance of the drainage system for surface water flow occurred during the snow melting and rainfall, in the beginning of summer season.
It is very important to improve the accuracy of the existing data on the regime and resources of the surface water forming in this region. For that regular measurements on precipitation and flood discharge passing through the dry beds during summer period should be done.

The regional water table is anticipated to be at a depth of at least 25 m below the ground surface. Based on the depositional history of the airport site, the potential for contaminated liquids to be transported through the fine-grained soils to reach the groundwater is low.

3.2.2 Ecological Resources

3.2.2.1 Fauna

The loss of habitat directly associated with ground disturbance from project development is unlikely to be significant. However, the secondary fauna impacts associated with aircraft noise, vehicles and increased population is likely to reduce the occurrence of wild animals in the vicinity of the project area. Due to frequent noise of aircraft, some wild animals including wild mountain sheep, gazelle, Asiatic wild ass and *Capra and sibirica (wild goat),* might move away from their habitats.

*3.2.2.2 **Bird strikes***

Due to the high bird diversity in the area, several species represent a bird strike risk including a risk to aircraft. The Cinereous Vulture has been identified as ‘high risk’-species, mostly with respect to high-level strike-risk for approaching aircraft. This nomadic bird builds its nest in elm trees and on rocks and when food is scarce, they migrate long distances. It is considered to be one of the most powerful birds, and a large number will gather on carrion and carcasses of dead animals.

Daurian Partridge, a permanent species which lives in steppes, ravines and cliffs, gathers in large numbers (usually observed in flocks of 10 to 20). It poses a low-level strike risk but also a possible high-level risk to approaching aircraft as it circles in large flocks at height.

3.2.3 Human Use Values

3.2.3.1 Land use patterns

The new airstrip and roads will not affect grassland but there are is herder property in the area, such as wells, winter camps, etc. Therefore no significant environmental or social impacts are anticipated. (Table 3.1) Around 130 hectare pasture is intended to be released for airstrip development; therefore, pasture releasing and compensation issues will be regulated according to articles 42 and 43 in the land law of Mongolia.

The building and road construction works will excavate some soil and consequently will inrease erosion. Heavy trucks, lorries and mining machinary will destroy fragile topsoil, which will also increase erosion and create dust in the surrounding area.

Total passenger number is around 250 during airport operation of landing/takeoff. Solid waste forms during loading cargo and luggage and it is expecting 5-10kg solid waste. In future, airport operation become as normal condition, number of flights are increase as 1-2 times per day, the solid waste will be increased much more.
Solid waste collects in specialized container and carries out in OyuTolgoi waste point 1 time per month.

3.2.3.2 Transportation

In the future, traffic density will increase due to number of flight a day. Transportation and its traffic will impact as long time (Table 3.1 and 3.2). Therefore, some measurements are needed to take to reduce dust emission such as to limit number of tracks (use bus etc) and vehicle speed (less than 15km/h).
Also, car parking is needed to build paved and solid type to be reduced dust emission as well. The paved road should maintain as permanently in terms of reducing dust emission and it is not need to create additional road channel.

3.2.3.3 Water supply

As a considered in the project, plane will be landed every day of a week in the new airport and about 250 customers will get a service. Fresh water demand per one flight should be (250 x 20l) 5 ton. This water can be transported from the treatment plant by tank-car and stored in the water storage reservoir. Then the used waste water can be accumulated in tanker and it should be transported by the special purpose tank-car to the water treatment plant every 3 days.
In case plane is landed 2 or more per day during dry period or during the high load , then it is necessary to decrease dust by watering the about 10 km long road using 10 ton water . If

we consider that this case will be happened ones per week or 26 times per year then 260 ton water will be used for that. The treated water from the treatment plant of Oyu Tolgoi can be used for this purpose.

Water treated by the treatment plant of Oyu Tolgoi meets the main requirements of MNS 4943 2000 state standard and can be used for the drilling technology and for the road dust.
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3.2.3.4 Power supply

Power generator using liquid fuels, emits CO, N2 and SO2, therefore, there is condition to pollute soil with oil production. Domestic airport will have own source of power generator. It is efficient for independent, but not optimum in terms of nature protection and economy. Therefore, monitoring of air and soil pollution in the Oyu Tolgoi site is needed and some protection activities should carry out for balancing of the nature environment.
Furthermore, when Oyu Tolgoi will have power main source in the future, the power generator should link to the centralized power system and at the time the generator only work as requested in significant circumstances.

3.2.4 Quality of Life Values

3.2.4.1 Socio-economics

The new airport site was chosen because it met the conditions required to satisfy a number of considerations, including proximity to future OT mine site development, future camps and accommodation, proposed future incoming power transmission lines, location relative to known mineral deposits that may be developed in the future and topography of local terrain.
Khanbogd soum center is extended in terms of number of population, when mining activities become complete; finally service for civil aviation is needed for the public. Therefore, it has to consider airport status as domestic airport, which is belong to the "Oyu Tolgoi" LLC, furthermore extent it as international airport and solve its public flight destination.

The most important benefit is that the new, well-organized, spacious and efficient Permanent Airport for Oyu Tolgoi will handle commercial traffic and become the image of Oyu Tolgoi in the South Desert Region of Mongolia.

3.2.4.2 Public health

It is possible to impact airplane noise at the airport and dust during the storm to the people in the day time as shortly, but its influence affect to the people in stayed permanently in Oyu Tolgoi site. Hence, if possible, use dust protection mask and need to prevent from airplane noise, when flights are highly increased.

Also it is requested to be clean waste water borehole as permanently and remove liquid mining waste into the integrated place. If there will be happen human and animals disease, the airport should shift work into the specialized warned condition.

3.2.4.3 Cultural, historic and archaeological aspects

There was not to discover cultural, historic and archeological find still now. But it is needed to warn new guest to protect cultural, historic and archeological find in the Khanbogd soum and should reflect special items in environmental induction.

3.3. Potential cumulative impacts

Cumulative impact means that multi interaction of ecosystem function which is integrated during Oyu Tolgoi permanent airport activities. The Cumulative impact is associated with environmental changes which form of activities of current and future impacts. In environmental impact assessment, we mentioned that there is potential to destroy soil in Gobi region and impact to vegetation cover in subchapter 3.1 and 3.2. For example, increase of traffic density and noise level. Table 3.3 shows potential cumulative impacts and some measurement to be reduced such impacts.

Table 3.3. Potential Cumulative impact and measurements

Potential Cumulative Impacts	Measurement
Road traffic capacity	Materials and equipment facility will be carried by tracks during construction phase of airport building. This is not much affected to the local traffics in terms of integrated impact. Therefore, road traffic capacity is enough.
Solid waste of building	Client partner is responsible for emitting as much as small waste, isolating them and cleaning the area. Excavated soil will be used airport construction. Generally, waste to be produced as minimum, therefore, there is no integrated impact in local area. Hence, solid waste impact to the local area is expecting as low.
Waste associated with airport activities.	Solid waste management plan will be implemented and purpose of this plan is reducing amount solid waste.
Increase of noise in local area	Noise level might be increased due to activities of construction and any other project implementation. Contractor client is responsible for minimizing noise level during activities. OyuTolgoi permanent airport is located

	relatively far from OT LLC employers camp and Khanbogd soum center, the impact of noise level to human health is low. However, it is highly preferable to cooperate with local people for determining potential noise impact in the future, any other conflict associated with airport service and activities are considered and solved as participatory way with local government and public. Noise integrated impact will low under these measurements.
Increase of dust concentration	There is probability to increase dust concentration during the construction phase of the airport, therefore, air quality will impacted by those activities. When transport freight materials by tracks, it is needed to protect them by cover materials against wind and pumping. Road in OyuTolgoi airport has to maintain as permanently and to spay water to be wetting. This case dust concentration will reduce and integrated impact is anticipating as low level.

4. ENVIRONMENTAL SAFETY AND RISK MANAGEMENT SYSTEM

The current domestic airport is devoting human and economic resources to the management of environmental, social, health and safety aspects. The experienced gained in the development of an environmental system will be applied to the operation of the new airport.

Accidents and emergencies shall be divided into the following two aspects based on the accident's environment, influence, loss and harm due to the runway operation:

- Emergency accidents and incidents
- Other industrial accidents

Emergency accidents and incidents

This includes harmful situations such as the aircraft accidents and incidents, fire, fuel and dangerous goods explosions, damage to the entities by bomb blast, unauthorized criminal aggression, natural disasters, etc.

In the above cases, the "Emergency Procedures" should be developed and adapted to the new domestic airport so as to avoid misunderstandings by local organizations, to change its joint activities and how to implement the emergency preparedness during and after the emergency situation at the New Oyu Tolgoi airport and near the airport area.

It will be more effective to prevent possible accidents and reduce their harm by developing and following this procedure including following conditions with a "cooperative work agreement" with the appropriate organizations with the approval of the head of the organizations.

The procedure includes following conditions:

- Aircraft accident and incident at the airport
- Aircraft accident and incident away from the airport
- Technical difficulties of flight which require emergency preparation for the implementation
- Fire at construction site
- Fuel and dangerous goods spill (See Table 4.1)
- Aircraft bomb scare
- Bomb scare at building
- Aircraft hijack
- Emergency relating to health issues
- Natural disaster

It will be more meaningful for the prevention of possible accidents and incidents and reducing the harm when the above emergency conditions are clear and there is appropriate

emergency coordination, management, adjustment, telecommunication, roads, appropriate organizations, departments and duty staff are able to determine the appropriate procedures.

Table 4.1. Fuel spill and risk assessment

Area of activity	Potential spill source	Potential Control Measures	Potential Spill Impact Considerations
Compress activity of fuel into diesel generator	Fuel bucket and tube break (for example fuel locking)/ stretching	▪ Be high attention ▪ To stop compression when accident occurs	▪ Size of spilled substance ▪ Time to know reason of spilling ▪ Distribution of substance ▪ Distribution of evaporation
Color and burning materials bucket, warehouse	Dropping from bucket Color bucket break and boring Evaporation	▪ To keep burning materials according to their standard ▪ Air condition	▪ Burning, toxic and any other dangerous substance ▪ Big size bucket ▪ Calculation of time for finding spill ▪ Distribution of substance ▪ Distribution of evaporation
Electro transformer	Heating	To prepare tube for weakening of pressure To protect area with fence	▪ Size of spilled substance ▪ Transformer has enough oil ▪ Calculation of time for finding spill ▪ Distribution of substance ▪ Distribution of evaporation
Toxic substance in cargo (harmful goods)	Break of bucket	▪ To keep substance in the isolated warehouse or area ▪ Be cement ground and isolated area from air ▪ Be sign label of warming, ▪ Be sign or map of dangerous goods transportation	▪ Potential size of substance into outside environment ▪ Calculation of time for finding spill to outside environment ▪ Distribution of substance ▪ Distribution of evaporation

In order to prevent aviation accidents and incidents, all aviation organizations' (weather, operations, management etc.) communication, information and coordination should be organized in close cooperation with higher management.

Possible accidents that may occur in Oyu Tolgoi include adverse meteorological phenomena and earthquakes. It must be taken into consideration that under special circumstances accidents may be influenced by dust storms during dry spring and autumn periods, and the airport itself may create conditions for the dust storms.

According to long term observational record, flash flood may occur only in case of short heavy of rainfall.

Following meteorological phenomena and conditions are considered as dangerous factors for flight. Ground level wind that exceeds the set limits for the runway, 15 m/s or higher wind in any direction; situations which reduce visibility, hail shower, rime, dust wind, thunder shower, dust or sand storm which reduces the visibility to less than 1000 m; the

level of the vertical visibility above the aerodrome which is 3 octant or higher; the temperature differences -30 ^{o}C or less and +40 ^{o}C or higher; sudden change of wind.

Gusty wind is a phenomenon when the speed of wind exceeds 15 m/s suddenly within few seconds and changes its direction. Sometimes the gust wind's speed reaches 20-30 m/s. The gust wind speed may even be constant 40m/s. Gusty wind is related with the frontal and internal mass lowering clouds. Gusty wind can danger or damage to low flying, landing and taking-off aircraft, operations and ground facilities that is on the aerodrome field. An aircraft can experience difficulties during approach and landing if gust wind occurred during the flight. This is the reason why the aircrafts are prohibited to fly under the lowering clouds.

Strong fog is dangerous extreme event for society, therefore, all transportation is dependent on fog, and especially it can interrupt aircraft transportation as temporary and continuously.

Oyu Tolgoi region belongs to high activity of seismic zone, which is reached to 8 magnitudes. Hence, it is need to follow earthquake standard when develop project design of construction of airport building, and it's maintain and extension.

Industrial and other accident

Aviation organization takes measurements to be satisfied for good structure, success, safety, none accident activities and illness. Success of combat industrial accident and illness depends on quality of analyzing current circumstances.

Measurements to be prevented from industrial accident

To be prevented from industrial accident, it is needed to establish safety office or employment for industrial accident and pay attention on following duties.

- In case, safety rule is violated, risky condition of the human life, health and safety has to be immediately removed
- Medical examination has to be done before entering of the job and clarify health condition and medical treatment is needed to be taken if necessary.
- Requested budget for measurements of safety activities condition has to reflect in annual budget, plan and contract.
- Approve and provide necessary worker dress and list of facility of protection
- Inform, investigate and inventory industrial accident according to established rule, and take urgent measurements and relief operation, when accident happens.
- To control and check safety of industrial equipment and facility (transportation, lifting etc), and approve and warrant it in time as permanently.
- To follow approved standard as mentioned above and to meet requirement of the environment condition.
- According to approved rule, it is needed to show benefits and exempt to employers, who are working hard condition.
- If employers breach safety rule of industrial accident, he/she has to be accounted up responsibility.

5. ENVIRONMENTAL MANAGEMENT AND RECOMMENDATION

The environmental impacts associated with the construction of the new airport will be mitigated through the implementation of Environmental Management Practices, which have been incorporated into an Environmental Management Plan for the construction of the Domestic Airport Oyu Tolgoi.

The proposed EIA complies with required environmental, social, health and safety and labor standards throughout its construction and operation.

5.1 Environmental and Social Mitigation Measures

5.1.1 Construction Phase

The Environmental Management Plan (EMP) includes industry practice mitigation measures such as watering of soil, covering of trucks, limiting activities to day time hours, etc to limit construction related impacts such as dust, noise and generation of waste. The EMP provides recommendations on how to incorporate into the design and construction, infrastructure civil works for the road, and communication with the communities affected by the construction of the road, among others. The following paragraphs describe the most relevant mitigation measures.

5.1.1.1 Flora and Fauna

Before commencement of the fill work, any organic matter existing on the ground, such as vegetation, etc. should be cleared. Filling work should be carried out in layers in order to achieve uniformity of the fill. The use of heavy machinery which could affect the stress condition of the underlying soft clay should be avoided in the initial earthwork stage, if possible. The construction activities involved in excavation and filling of the earth materials should be carried out during the summer and autumn period of the year.

5.1.1.2 Erosion

Soil erosion as a consequence of vegetation clearing preceding construction activities can be minimized by replanting and turning. Therefore, it may be necessary to incorporate artificial erosion protection measures such as facing of escarpments, paving of taxi way flanks and lining of drains. For example, it is recommended to avoid many new road branching by the heavy tracks and needed to take measures against soil erosion.

Main requirement of biological rehabilitation is to plant vegetation as much as possible to reach local land cover feature. Therefore, vegetation species in used rehabilitation are

matched with vegetation cover surrounding in 50km radius. Name and species of vegetation is selected based on location and natural zone of rehabilitation area. For instance, perennial (Anabasis brevifolia, Reaumuria soongorica, Eurota ceratoides, Salsola passerine, Allium polyrrhizum) and annual plants (Halogeton glomeratus, Micropeplis arachnoidea) are revegetated in rehabilitation of airport airstrip. Among the bush type plants, Ulmus, Haloxylon Bunge and Tamarix are much more proper to re-vegetate.

Cover plants could grow from seeds and has capability to accumulate biomass, hence, its important role is to balance soil moisture and heat regime, and shade from the sun in the first year of growing stage.

A storm drainage system consisting of ditches, channels and storm sewers will further mitigate erosion of surface soils. The storm water drainage system design for all developed areas of the airport is based on zero discharge to the environment for all rainfall events up to the 1 in 100 year rainstorm of amount 100-125 mm over 24 hours. The collected water would be used to irrigate adjacent fields and airport landscaping.

5.1.1.2 Air quality

Standard dust-suppression measures will be used to keep the dust to a minimum as detailed in the EMP for construction. Among the principal measures to control dust are the use of uncontaminated water spray to areas vulnerable to dust-generation; the storage of aggregates downwind of suitable natural or artificial barriers or windbreaks, covering of large amounts of bulk fine construction materials (e.g., concrete, lime); regulating construction equipment and contractor vehicle movements on and off-site. To reduce the amount of dust generated during the process of dumping or pouring of fine granular material or aggregate, the height of the fall of the material will be regulated to reduce the exposure time of the material to the wind.

To mitigate negative impacts caused by air contamination as a result of exhaust emissions from heavy transport vehicles and machinery, equipment and machinery will be suitably maintained, especially those powered by internal combustion engines using fossil fuels and idling of vehicles will be kept to a minimum when not in operation. The use of equipment, materials or machinery that produce unacceptable levels of gas emissions, smells, or smoke into the atmosphere will be prohibited.

In the engineering design stage, runways for landing and takeoff should be designed to handle maximum dispersion of air pollutants. Regular inspection of air quality in the airport vicinity is recommended (Table 5.1). In case air quality in the airport vicinity deteriorates beyond the recommended standards and severe impacts should result, consideration should be given for controlling emissions within the Airport area.

5.1.1.3 Noise

The noise impact of construction activities will likely be associated with heavy equipment movements on and off the site. Work will be planned to minimize traffic during night-time hours and avoid unnecessary and inefficient traffic.

5.1.1.4 Waste

Contractor will be responsible for all waste disposal from construction site to specified place. Waste disposal issue will be controlled by OT environmental office or waste management centre. Recycling and reuse of materials will be encouraged.

5.1.1.5 Fuel Storage

During the construction phase, it is recommended to avoid storage of fuel in the construction area. In case, it will be kept to a minimum, assuming that it proves possible to arrange for a fuel supplier to deliver and fuel equipment on-site.

5.1.1.6 Archaeology

If archaeological sites or artifacts are discovered, an archaeologist will determine the appropriate on-site mitigation procedure.

Controlling and monitoring activity of negative impacts in airport construction phase

Additional recommendations on negative impact reducing in Permanent Airport construction phase and needed inspection and monitoring activity are given in Table 5.1

Table 5.1. Construction Mitigation and Monitoring Activities

Environmental Effect	Construction Mitigation and Monitoring Activities	Construction Monitoring
Air quality, toxic substances emission	• To use less sulphur fuel • To switch off the engine during stopping , conduct technical maintenance on regular basics to minimize emission,	Monthly checks to ensure that construction plant, equipment and vehicles are being regularly serviced and maintained to vendor specifications
Air Quality, Dust Emissions	• To reduce bare surface • To reduce traffic and speed on unpaved road • To tightly cover piles and pits • To take other measures such as covering during dry and windy condition	Weekly site inspections to ensure that areas of bare earth are being minimized and that soil / aggregate stockpiles are covered; and As required site inspections to ensure that wetting down of dust generating areas is occurring in windy and dry conditions

Water quality, soil Erosion	• To control activity to reduce duration and area size of land stripping • To cover, protect surface, select adequate slope and locations, if piles needed to stand longer • In order to reduce soil erosion and soil baring during building and road constructions, to steep slope, plant as soon possible • To control and monitor to prevent to branch out water discharge canal and outflow to unplanned place • To ask permission from local authorities if need to use quarry to extract soil in airport zone	Piles and pits sites should be provided and controlled by needed erosion and sediments measurement equipments To control at sites every week; To monitor construction activity every weak To control water discharge system safe every week during rainy season Should be detailed and extended to this EIA report
Soil pollution by fuel, cement and luquids	• To locate fuel and chemical toxically substances storage container with leak proof fully protected tank at place a rounded by soil dams • To prevent sudden fuel leak and spread • To immediately remove out and clean if fuel leak happened • If pollution exceeded allowed values take immediately needed measures, stop activity until pollution damages will be **fully** prevented •	To control pollution every week;
Biodiversity habitations	• To minimize negative influence of land stripping and heavy vehicles movement during airport and road construction work in soil and pasture vegetation cover of subarea • To move bird's nest involving local biologist preventing negative consequences on reproduction and wrong actions •	To control biodiversity habitat destroyed or not? due to constructions work every week To monitor impact mitigation plan implementation
Construction waste	• To comply sanitary and healthy requirements	To control waste storage, transporting, removal according to the scheduler

		every week
Acoustic	• To refuse from activities with noises from 10 p.m to 7 a.m • All equipments and machinery should work satisfying requirements of standards without extra noises, switch off if not used • Loading/unloading, assembling/reassembling of mechanism shall be done during daytime • To investigate noise sources and causes.	To control equipment's normal operations and maintenance technical service timetable every month To measure noise level at construction area and boundary every month to approve accordance with international permissible value and in case of complain
Local traffic movement	• . To provide safety in more attention needed places • To take measures to provide safety in high risk places by inserting warn signs • . To regulate speed, limit and control • . To provide safety using lighting and signal in case of heavy and large size transporting • Transporting of materials and equipments should de schedule red to minimize number of trip	. Traffic route should be efficiently planned ; Vehicle's arrival to field should be schedule red in advance; . To control transporting/shipment to/from field every month in order to approve adequate traffic movement controlling measurement implementation . To control road congestion, condition, destruction every month conduct measurements . Heavy and large size transporting should followed by extra car
Cultural Heritage and Archaeology	• To inform related local governmental and related authorities in case of historical and cultural valuable findings • To introduce guidelines on what to do if findings are recovered	To check existing plan of historical and cultural valuable findingы To control actions taken to protect recovered findings
Safety of public and workers	• . To operate public warning system, inform traffic scheduler of heavy vehicles movement on field and road • To ensure healthy and safety of workers during construction phase	To control safety actions rules compliance To monitor implementation

	• To protocol emergency cases and accidents • To prepare in advance contact person list in case of emergency • . To prepare emergency response action plan and provide favorable condition to implement it • . To train staffs and contractors on implementation of emergency response action plan	according to plan every week

Contractor (Oyu-Tolgoi LLC)' control for negative environmental impact reducing during permanent airport constructions in Oyu-Tolgoi is important to protect environment, therefore above mentioned recommendation should be implemented through an environmental protection plan.

5.1.3 Operation Phase

5.1.3.1 Noise

Source specific noise mitigation measures included in the EIA for consideration at the Permanent Airport may include:

- ⇨ regulation of engine run ups;
- ⇨ regulation of Category of aircraft using the facility;
- ⇨ use of low noise-emission road surfaces;
- ⇨ noise barriers,
- ⇨ Development should be encouraged to move people away from areas which will be severely affected by aircraft noise in future; these include the areas on the north side of the airport.

5.1.3.2 Air Quality

Three principal mitigation measures have been investigated to confirm that high predicted pollutant levels could be lowered sufficiently to meet ambient air quality standards. These measures include the use of replacement of gasoline or diesel fueled ground service for electrical equipment, the substitution of motor vehicles (it is assumed that the motor vehicles would be displaced by modern buses and that each bus would displace several cars). All of the mitigation measures, except changing flight time, can reduce air pollution and hence achieve compliance. Because the airport is at a conceptual design stage specific measures have not been determined at this time. Other mitigation measures that can be investigated if necessary in the future include ground transportation changes, ground support equipment changes, and aircraft movement control, flight scheduling, parking controls to reduce idling time and motor vehicle fleet changes.

5.1.3.3 Bird strikes

Measures to mitigate against bird-strike risk from vultures will include limiting the presence of domestic livestock; ensuring good husbandry of any livestock, including immediate removal of sick livestock; ensuring good waste disposal facilities and practices on-site, particularly for organic wastes (e.g., food waste from restaurants); and controlling the location of local garbage tips and prohibiting illegal dumping near the site.
The immediate removal of a dead animal's body or carrion is required before birds such as *Cinerous Vulture* gather.

5.1.3.4 Ecological resources

An open area on the north-eastern side of Oyu Tolgoi should be reserved as grassland. The area should be kept free from urbanization and promoted as feeding grounds for many animal species. To minimize flocking of birds, land use pattern within and without the airport must be carefully planned. Bird scaring devices may be employed for the safe landing of aircrafts.

5.1.3.5 Waste

Off-site waste disposal of waiting areas for the passengers and other domestic waste will be clearing and removing. Sewage will be collected in a septic tank and removed by truck.

5.2 Environmental Monitoring Programs

Environmental monitoring program are recommended to support normal control systems and emergency preparedness. A brief summary of environmental management and monitoring programs for the future Permanent Airport OT being proposed are as follows:

- The Environmental Management Program contemplates various monitoring programs to be implemented during the construction phase, including vegetation and habitats, erosion and air quality monitoring programs. For example, the ambient air quality monitoring program for construction will consist of one time air sampling for dust per week on one minute interval for hour at the site. One monitoring point will be placed to the north of the construction zone and one to the south. Since the wind is predominantly from the north, the north monitor will provide a background concentration and the south monitor should give an indication of combined construction emissions and background levels.
- During the operation of the airport, air quality sampling will be analyzed once per month. Noise will be also monitored both at the Permanent Airport and at the receptors.
- "Oyu Tolgoi" LLC need to posses and maintain noise and air pollution measurement equipment to ensure monitoring and control.

- If financial resources are available to support the abovementioned programs, it would be beneficial in a few years to assess and handle future ecological environment issue based on post project analysis.
- To maintain correct and accurate recorded data to the population and business people.
- Specialized training program for the involved population.

An environmental protection plan and monitoring programme are included in the next chapter.

6. "ENVIRONMENTAL PROTECTION PLAN" OF PERNAMENT AIRPORT PROJECT

Implementation Organization: "Oyu Tolgoi" LLC

6.1 ACTIONS RELATED TO TECHNIQUES AND TECHNOLOGIES OF AIRPORT CONSTRUCTION

6.1.1 Air pollution prevention

6.1.1.1 Impact description

- ✓ While constructing airport building, dusts from earthwork at the construction site, movements of vehicles, loading/unloading of construction materials, road exceed the permissible maximum value, it would negatively impact on population health, soil and vegetation cover.
- ✓ Exhaust gas and smoke from vehicles, techniques and machineries have would negatively impact on air and soil pollutions.

6.1.1.2 Affected objects

- ✓ Population, vegetation, water and soil

6.1.1.3 Permissible maximum values of standards

Permissible maximum values of chemical and physical originals wide spread pollutants are based on air quality, technical general requirements MNS 4585:2007 standards

Pollutants	Measurement temporal range	Unit	Permissible maximum level
CHEMICAL IMPACT			
Sulfur oxides (SO_2)	10 min's average 20 min's average 24 hour's average Annual average	µg/м^3	500 450 20 10
Carbon dioxide (CO)	30 min's average 1 hour's average 8 hour's average	µg /м^3	60000 30000 10000
Nitrogen oxides (NO_2)	20 min's average 24 hour's average Annual average	µg /м^3	85 40 30
Dust (Total Suspended Particles)	30 min's average 24 hour's average Annual average	µg /м^3	500 150 100
Large size particles of dust (PM10)	24 hour's average Annual average	µg /м^3	100 50
Fine particles of dust (PM2.5)	24 hour's average Annual average	µg /м^3	50 25

PHYSICAL IMPACT			
Noise:			
• Daytime (between 07-23):	16 hour's average	dBA	60
• Nighttime (between 23-07):	8 hour's average		45

6.1.1.4 Measures for impact reducing and preventing

№	Actions to be taken	Time	Budget (thous,₮)	Responsible part
1.	During the airport construction, while dust is increased, take measure to reduce dust such as sprinkling, covering of fine structured materials like cement, sandy and etc • Sprinkling once a week, totally 32 times, during 8 months. Used by CB /treated water will be used. Each time 5 tons water, totally 160 tons water is requested. Water transport cost is 10.000₮, totally 320.000₮	2011	320.0	"Oyu Tolgoi" LLC , Environmental department and Construction contractor
2.	Air sampling for dust(PM_{10}, $PM_{2.5}$) analysis (one sampling will be continued 1 hour with intervals of 1 min) • DustTrak Aerosol Monitor equipment will be used. Once weak, in total 32 times. Car fuel cost of one measurement 10000₮, in total 320.000₮	Once a week, during construction work	320.0	"Oyu Tolgoi" LLC, Environmental department
	Total		**640.0**	

6.1.2 Physical impact prevention

6.1.2.1 Impact description

- ✓ Noise and vibrations caused by heavy machineries operations at construction site and buffer area would affect negatively on workers health.

6.1.2.2 Affected objects

- ✓ Workers and citizens living in impact scope

6.1.2.3 Permissible maximum values of standards

- ✓ MNS 4585:2007 (see physical impact in Table in 1.1.3)

6.1.2.4 Measures for impact reducing and preventing

№	Actions to be taken	Time	Budget	Responsible part

			(thous,₮)	
1.	Noise level measurement (at site by NL-04 equipment) Once a month during 8 months, noise level will measured by NL-04. If rent above equipment from Central Laboratory or OS MT LLC, rental cost20000₮ in time, totally 20000₮ X 8 times	During Construction work	160.0	"Oyu Tolgoi" LLC, Environmental department
	Total		**160.0**	

6.1.3 Actions for soil pollution reducing and land rehabilitation

6.1.3.1 Impact description

- ✓ During the construction work, soil will be depredated and dust amount will be increased.
- ✓ Metal content in soil will affect directly and indirectly on human health

6.1.3.2 Affected objects

- ✓ Soil quality/sanitary and fertility near the airport
- ✓ Workers, fauna and flora, ecological unbalance

6.1.3.3 Permissible maximum values of standards

Soil quality. Permissible maximum values of soil pollutants are defined in the MNS 5850:2008 standards. If value of certain elements exceeds the permissible maximum values soil is accepted as polluted. (see Tables 2-4 of standards).

6.1.3.4 Actions for impact mitigation, preventing and environmental rehabilitation

№	Actions to be taken	Time	Budget (thousand,₮)	Responsible part
1.	Recovering of soil degradation and erosion during construction work, land rehabilitation: • Both sides with 50 m length and 16.25 hectare area among airport taking off/landing runway with 3,250 m length • Pathway, safety ending (100m x 10m) strips, plateau, airplane standing site(50m x 20m) - 0.2 hectare, • Degradation land from metallic fences of with 8000 m length outside of runway, car park, airport building and terminals,	During construction work	14730.0	"Oyu Tolgoi" LLC

	(8000 x 2) - 1.6 hectare area, • Building of terminals, control tower and car parks - 1.0 hectare area, • Land rehabilitation of aside area of 50 meter's strip among gravel road with 5.2 km length and 26 hectare area, totally 42.65 hectare area is needed to be rehabilitated by filling pits. Cost of one hectare area is 100.000₮, total cost is 8530.000₮ • Planting cost of 1 hectare area is 100.000₮ , cost of 42 hectare area is 4200.000₮			
2.	Soil sampling for pH, sulphate, nitrate analyzing (at construction site). Laboratory of Institute of Geography may be used. Cost of one sample is approximately 50000.0 ₮	2 times during construction work	Total: 100.0	"Oyu Tolgoi" LLC
	Total		**14830.0**	

6.2 ACTIONS RELATED TO TECHNIQUES AND TECHNOLOGIES DURING AIRPORT OPERATING

6.2.1 Aactions to prevent air pollution

6.2.1.1 Impact description

- ✓ If air pollution caused by aircrafts' taking off and landing and diesel station exceeds the permissible maximum value, it may have negative impact on human health, soil and vegetation cover.

6.2.1.2 Affected objects

- ✓ Population, vegetation, soil

6.2.1.3 Permissible maximum values of standards

- ✓ It has shown in 1.1.3 above.

6.2.1.4 Actions for impact mitigation, preventing and environmental rehabilitation

№	Actions to be taken	Time	Budget (thous,₮)	Responsible part
1	Measures to be taken to reduce dust • Sprinkling using 5 tons water among 5,2 км length roads. If twice a week, 104	For 2011-2015	5200.0	"Oyu Tolgoi" LLC

	times per year. Totally 520 tons water will be consumed. There is option to use used/treated water from water treatment system. Water transporting cost is per one route 10000.0 ₮, per 5 years 520000 ₮, per 5 years 5200000.0 ₮			
2.	Air dust sampling ($PM_{10,}$ $PM_{2.5}$) at runway and road area during one hour with 1 min interval) • Oyu Tolgoi" LLC can use DustTrak Aerosol Monitor equipment once per 2 weeks. Fuel cost is 10000.0 ₮, 26 times per year, 130 times per 5 years requesting 1300000.0 ₮.	For 2011-2015	In total: 1300.0	"Oyu Tolgoi" LLC, Environmental department
3.	Air pollution sampling (NO_2, SO_2, CO) (airport building, road) • Once per year by EML equipment, once per year, fuel cost is 10000.0 ₮, equipment rent cost is 30000₮, and 3 times x 30000₮, totally 100000.0 ₮ is needed. Totally per year 1200000₮	For 2011-2015	In total: 5600.0	"Oyu Tolgoi" LLC, Environmental department
	Total		**12100.0**	

6.2.2 Mitigation of physical impact

6.2.2.1 Impact description

- ✓ Noise and vibrations caused by heavy machineries operations at construction site and buffer area would affect negatively on workers health.

6.2.2.2 Affected objects

- ✓ Workers and citizens, animals living in affected zone,

6.2.2.3 Permissible maximum values of standards

- ✓ MNS 4585:2007 (see table in 1.1.3)

6.2.2.4 Actions for physical impact mitigation and preventing

№	Actions to be taken	Time	Budget (thous,₮)	Responsible part
1	Noise measurement at airport • Once a month, using own equipment or renting. Fuel cost is 10000.0 ₮, totally 60 times with 600000.0 ₮ requested	Once a month, for 2011-2015	600.0	"Oyu Tolgoi" LLC, Environmental department
	Total		**600.0**	

6.2.3 Measures to reduce soil pollution

6.6.2.3.1 Impact description

- ✓ Soil pollution will affect directly and indirectly on human health.

6.2.3.2 Affected objects

Soil hygiene/sanitary and fertility

- ✓ Workers
- ✓ Flora, fauna, ecological unbalance

6.2.3.3 Permissible maximum values of standards

- ✓ It is given in chapter 1.3.3.

6.2.3.4 Measures to be taken to reduce impact prevent and rehabilitate environment

№	Actions to be taken	Time	Budget (thous,₮)	Responsible part
1.	OT will plant a tree about 100 pieces of Gobi Elm, Popular outside of Zone B means 10 km radius of Permanent Aerodrome; (themselves can prepare seedlings). *(following normative approved by 222/109decree issued in 2001 jointly by Nature/Environment and industry/trade ministers, attachment 1)* • If bought seedlings, cost is 125000 ₮ • Irrigation and taking care work cost per month during warm season is 300000₮, per 3 years during 18 months 5400000₮ are needed	2011-2015	5400.0	"Oyu Tolgoi" LLC, Environmental department
2.	Waste from airport and other sources will be removed on regular basis. Waste will be transported and discharged at special waste points. Petrol cost 10000₮. 60 times for 5 years. In total 10000₮ x 60 times = 600000	2011-2015	600.0	"Oyu Tolgoi" LLC
3.	Soil sampling for pH, sulphate, nitrate analyzing (at construction site). Laboratory of Institute of Geography can be contacted. Cost of one sample is approximately 50000.0 ₮, 5 samples request 250000₮.	Once per year, 2010-2015	250.0	"Oyu Tolgoi" LLC, Environmental department
	Total		**6250.0**	

6.3 Administration and management activities

№	Actions to be taken	Time	Budget (thous,₮)	Responsible part
1.	Take necessary actions to reduce air pollution by replacing machinery used petrol by electronic equipments, replace some machinery (for example use bus instead of several small car)	For 2011-2015		"Oyu Tolgoi" LLC
2.	The plate steppe area in the east-north of the Oyu-Tolgoi mining site will be maintained as pasture and there no any construction and mining. The area will be kept for the animal pasture. Consider for airports and surrounding areas land management planning to eliminate the bird's gathering condition	During airport operating	-	"Oyu Tolgoi" LLC
3.	Before starting construction of the new airport, it is strongly recommended to construct enclosure around the given licensed area and to prohibit heavy truck's traffic outside of the enclosure.	2011		"Oyu Tolgoi" LLC
4.	Road which uses for transportation of materials from quarry should be to maintained to avoid generation of dust in the vicinity of the new airport area	2011		"Oyu Tolgoi" LLC
5.	Establishment of regular monitoring system for noise and air pollution at the airport area, conduct on operational way, procures measurement equipments needed for it.	2011-2015	-	"Oyu Tolgoi" LLC
6.	Fuel supplier will coordinate supply the fuel directly to the field, choice right places to locate fuel techniques avoiding of fuel keeping near airport.	2011-2015	-	"Oyu Tolgoi" LLC
7.	Remove and clean up immediately animals scavenges from the airport area to avoid birds gathering and bumping with airplane	2011-2015	-	"Oyu Tolgoi" LLC
8.	Conduct regularly customer's control and monitoring and take inspection measures as recommended in chapter 5 of this report (table 5.1)	2011-2012	-	"Oyu Tolgoi" LLC
9.	Follow the related labor safety instructions and guidance, arrange medical checkup and treatments for workers every year	2011-2015	-	"Oyu Tolgoi" LLC

10.	Develop the procedures and rules to be acted in emergencies cases, regular training of workers for preparedness. The potential possibility and risks assessment should be conducted by the professional inspection authority	2011-2015	In total: 1000.0	"Oyu Tolgoi" LLC
11	Submit annual report on environment protection and rehabilitation activities to the Ministry of Nature and Environment and Environment Department of Umnugobi aimag within requested date	2011-2015	300.0 every year, In total 1500.0	"Oyu Tolgoi" LLC
12	Allocate environment protection budget in the annual business-finance plan.	2011-2015	-	"Oyu Tolgoi" LLC
	Total		**2500.0**	

Total budget: 37080.0 thous.tug

Environmental protection annual expenses: 7416.0 thous.tug

7. ENVIRONMENTAL MONITORING PROGRAMM OF PERMANENT AIRPORT RELOCATION PROJECT

Project implementation organization: "Oyu Tolgoi" LLC

7.1 AIRPORT CONSTRUCTION PHASE

7.1.1 Air

Monitoring method: Ambient air
Location: at 0.1 km in the north and 1 km in the east-south, wind down side, from airport runway (at 2 points)
Characteristics: Dust (PM_{10}, $PM_{2.5}$),
Time, frequency: once a week during 8 months (from April to December)

7.1.2 Noise

Monitoring method: Surrounding area physical impact
Location: Heavy mashineries traffic area at construction site and out area
Characteristics: Noise level
Time, frequency: once a month, totally 8times

7.1.3 Soil

Monitoring method: Ambient soil (from 0-10 sm depth)
Location:At 0.5 km distance in the east from airport construction (at 1 point)
Characteristics: pH, sulphate and nitrate
Time, frequency: one month before and after airport constrution work (in total 2 times)

7.2. AIRPORT OPERATION PHASE

7.2.1 Air

Monitoring method: Ambient air
Location: near runway and road (at 2 points)
Characteristics: NO_2, SO_2, CO
Time, frequency: once a month, 12 times per year, in total 60 times

7.2.2 Dust

Monitoring method: Ambient air
Location: Near to airport workplace
Characteristics: PM_{10}, $PM_{2.5}$

Time, frequency: once a 2 weeks, 26 times per year, in total 130 times

7.2.3 Noises

Monitoring method: Environmental physical impact
Location: At the airport and workplaces
Characteristics: Noise
Time, frequency: once a month, 12 times per year, in total 60 times

7.2.4 Soil

Monitoring method: Ambient soil (from 0-10 sm depth)
Location: at 0.5 km distance in the east from airport (at one point)
Characteristics: pH, sulphate and nitrate
Time, frequency: once a year

7.2.5 Equipments

- The **"**Oyu Tolgoi" LLC recently has dust monitoring DustTrak equipment, in the further may be to purchase equipments for air pollution and noise measurements.

- At airport construction and beginning of operation phase measurement of air pollution and noise level may measured by rented equipments from professional organizations as Environmental monitoring Laboratory (EML). Soil samples may analyze in the Soil Laboratory of Institute of Geography.

7.2.6. Data processing and reporting

The Environmental monitoring annual report should be submitted to the Ministry of Nature and Environment and Environmental Department of Umnugobi aimag by December of each year.

8. INSTITUTIONAL FRAMEWORK AND LEGISLATION ISSUES

8.1 The Ministry of Nature and Environment acts as the authority, coordinator and regulator of the national decentralized system of environmental management. Among the principal responsibilities of the Ministry of Nature and Environment is the responsibility to prepare a national territorial plan, present environmental management regulations, evaluate environmental impact procedures for approval of environmental studies & plans and coordinate with other national authorities and issue technical standards, manuals and general parameters for environmental protection.

8.2 The Municipality of Umnugobi aimag has its own regulations for the approval of environmental studies and is legally authorized to approve environmental studies within the boundaries of its territories. The Municipality of Khanbogd soum is the owner of the territory of the Oyu Tolgoi Airport and supervises the Airport (as a concessionaire) in the areas of administration, improvement and maintenance and contractual agreements.

8.3 The Civil Aviation Authority of Mongolia is an independent body of the Mongolian Air Force and is responsible for establishing regulations and standards for aircraft and air traffic used throughout Mongolian airspace, including at the Oyu Tolgoi Airport.

8.4 The Ministry of Culture, Education and Science is the state organization that develops regulations to prevent and mitigate damages to cultural heritage. Ground disturbing projects must submit an archaeological report to the Ministry to receive clearance to proceed with the Project.

8.5 The National Emergency Agency of Mongolia is the controlling body for industrial health and safety.

8.6. LAW AND LEGISLATION ISSUES ON THE ENVIRONMENT

Major basis of the Ecological Legislation is considered law. The law is based on the Constitution and determines the coordination of the ecological legislation and implementation method.

> "The citizens of Mongolia …. The right to live in the healthy and safe environment, and to be protected against environmental pollution and ecological imbalance," – as stated in the Article 2, Chapter 16 of the Constitution of Mongolia

Living at the Safe Environment is a condition which includes the prevention of the decline of living standards, pollution, danger and accidents caused by negative human influences and environmental changes. Protecting any damage of natural balance is a right to live at the protected area which prevents from the mutual cooperation standard of environmental structure situation and its component items. The environmental protection legislation includes these articles.

The protected objects which are included in the ecological legislation are as follows under the article 3 of **Law on the Environmental Protection**: "This Law shall protect the

following conservation resources from any adverse effects to prevent ecological imbalance:
- Land and soil;
- Underground resources and mineral wealth;
- Water;
- Plants;
- Animals;
- Air.

Above article of this law is an approval of the direct purpose of the ecological protection legislation.

The indirect object of the ecological legislation protection includes people and their health and safe environment. One of the components of the environment is a human being. Therefore, a human is an object of the ecological legislation protection.

Within above content of the Constitution of Mongolia, the Law of Mongolia on Environmental Protection includes all issues relating to the environment and will be studied as a foundation.

Therefore, the detailed environment impact assessment shall be studied and prepared under the Law of Mongolia on Environmental Impact Assessment, which is determined by above views of the law.

According to the detailed environmental impact assessment, the population health and possible harmful impact to the environment should be determined in advance and determine its reduction step to implement the project. The above main purpose is to provide and follow firmly the requirement of the law on environment during the planned activities of the Project. The environmental standards of the items which are Indicated on the environmental assessment, are approved by certain legislation acts. Therefore, the project authority shall follow them.

The related issues of the detailed environmental impact assessment are indicated in the Law of Mongolia as follows:

Environmental baseline data and indices;

The optimal alternative of the project and technology;

Recommendation on measures to mitigate and eliminate potential and significant adverse impacts;

Analysis and calculation, which determine the amount, spreading and consequences of the project;

Risk Assessment;

Environmental Protection Plan;

Environmental Monitoring Programme

Opinions of local citizens, the Presidium of the Citizens' Representative Khural of soum and duureg;

Other issues interconnected with the cultural strata of the locality where the project is to be implemented, and the peculiarities of the project;

In that case, the Economic entity which obtained the license to conduct environmental impact assessment shall consider and implement its assessment work under above issues.

The report of this work shall be submitted to the State Administrative Central Organization in charge of nature and environment (Ministry of Environment) and Expert shall do the assessment analysis during 18 working days and the Ministry of Environment shall decide the problem of the project implementation.

The report of the environmental impact assessment includes the preventing activity of the possible negative impacts, mitigating or eliminating the adverse impacts which were identified during the Detailed EIA and development of the Environment Protection Plan and the Environmental Monitoring Programme. Relating above situation, under the Law of Mongolia on Environmental Impact Assessment, the project proponent shall develop the Environmental Protection Plan and Environmental Monitoring Programme for the purpose of implementing the recommendations and conclusion of the EIA and to monitor and control its own process and performance.

According to the law, the State Inspectors of the Environmental Protection, Citizen Representative Khural of the capital city, aimag, soum and district, and their Presidium shall do the control on project implementing plan and programme. If human health or property are suffered from the conducting the project implementation without the impact assessment or due to the non-compliance with the requirements stated in the EIA, then the harm shall be eliminated and confiscated by the guilty party.

The law which is an origin of the ecology, divided into 2 types: The law with direct and indirect origin are used for a citation.
The Law with Direct Origin of the Ecological Legislation**,** for example, the following laws is included in the type of environmental issues and will be a legislative origin of this project activity and assessment work which is to follow directly:
The Law of Mongolia on Environmental Protection
The Law of Mongolia on Environmental Impact Assessment
The Land Law of Mongolia
The Law of Mongolia on Land Fees
The Underground Law of Mongolia
The Law of Mongolia on Air
The Law of Mongolia on Water
The Law of Mongolia on Water and Mineral Water Use
The law of Mongolia on Natural Plant
The Law of Mongolia on Plant Protection
The Law of Mongolia on Fauna
The law of Mongolia on **Forest and Field Fire Prevention**.
The law of Mongolia on the Industry and Home Rubbish etc.

From above laws, the related articles are as follows:
According to the Mongolian Law on Land, Article 32, the Land Possession Contract and Procedures for its Conclusion is as follows:

1. Based on the land possession decision, the official appointed by the Soum and Duureg Governors shall enter into a contract on land possession with citizens, economic entities, and organisations, and then grant a certificate and register the contract with the State Registry.
2. The following shall be included in the land possession contract:

1. Justification on land possession (appropriate decision);
2. Purpose of land possession;
3. A map showing the size, location and boundary of the land;
4. Land characteristics and quality;
5. Duration of land possession;
6. Land fee amount and payment deadline;
7. Rights, responsibilities, and obligations of the contracting parties;
8. Agreement on construction and other properties upon expiration of land possession right;
9. Conditions and procedures for altering or taking the land possessed with compensation;
10. Other issues considered necessary.

The land owner shall submit its State certificate's prolongation request to the appropriate Governor 30 days before the end of the validity period and the following documents shall be attached:

1. The State certificate of land possession;

2. The receipt of the land fees

3. The reference letter regarding the implementation of the environmental impact assessment results

According to the Article 50 of this law, there is a common requirement of the efficiency land use and its protection as follows:

Land possessor and user shall meet the following requirements on efficient and rational land use and protection:

1. At their expense, preserve land characteristics quality, as well as prevent the reduction of soil fertility, overgrazing of vegetation cover, soil erosion, degradation, drought, saturation, salinization, pollution and chemical pollution caused by nature or human activities.
2. Immediately restore eroded and damaged land;
3. Maintain and restore land changed due to tests, experiments, and mineral exploration;
4. Prevent adverse impacts to the environment and land due to use of the land, its resources and commonly distributed mineral resources;
5. Preserve and protect land with small forested areas, rare and endangered animals and plants, and cultural and historical moments;
6. Prevent activities with potential adverse impact to the environment, land possessed or used by others, and State owned land;

According to the Article 51. the Sanitary Land Use Requirements are as follows:

1. Citizens, economic entities and organisations shall obtain, at their expense, an environmental impact assessment from the authorized organisation prior to developing land use proposals and maps, introducing new technology, using chemicals or fertilizers which have not previously been tested in Mongolia.

2. Citizens, economic entities and organisations shall construct buildings and install equipment which have potential adverse impacts to environmental balance, human health, livestock, animals, air, forest water and plants as well as store and discharge industrial wastes waste water; toxic and other substances only with the permission of the authorized Professional organisation.

As indicated at the **Law of Mongolia on Land fees,** Land fees shall be charged to the business entities, and organizations with fees for possessing and/or using state-owned land according to land possession and/or usage contracts. The land base rate shall be determined by the Government. The Land fee shall be charged at a percentage of the base value of one hectare land and the land fee range is 0.01-0.03 %. The land fee shall be counted by the amount possessed and/or state-owned land usage. The amount of land fee shall be determined by the Government, within the ranges specified above, for each agricultural land zone, city, village, and other settled places according to their land rate. The Government shall decide whether to provide partial land fee or whole exemption to citizens, business entities, and organizations who use technologies to protect or rehabilitate land or environmentally friendly technologies. Land fee payers shall pay, unless stated otherwise in the contracts, the fee by the 25th of the first month of each quarter dividing the annual land fee into equal amounts, and may pay the next quarter installments in advance. Land fee revenue shall be put to the soum budget.

As indicated in the **Law of Mongolia on Air**, the economic entities and organizations shall provide the information concerning its activity influencing the air quality and internal control to the Specialized Department of the Local Administration at certain time. Also, if the polluting substance's components and the level of physical harmful influences in the air are increasing seriously, and its capacity exceed the standard norms, and it is too harmful and dangerous to the human health and nature due to an emergency, industrial accident and others etc. the organization in charge shall inform this information to the aimag, city, soum Governor and public promptly. The cause of the increasing air pollution and physically harmful influences are determined and are removed by the Head of organization, the Specialized Department, and Governor and related other organizations.

The special procedure shall be determined at the internal activity of organization, and its activity shall be stopped temporarily, and to protect and move the public if necessary according to the Law of Mongolia on Civil Protection for the purpose of decreasing the air pollution and physical harmful impacts.

The following works such as choosing the location of the constructions which will be used for service and other use, creating the draft drawing, building them, giving the exploitation, maintaining, changing and renewing the technique and technology shall be based on the

standard for the level of physical harmful impacts and the capacity of air polluting substances.

The environmental impact assessment shall be made at the economic entity and organization who will run the activity to influence physical harmful influence and emit air polluting substances during its 1st stage of construction work. .

The organization shall provide its equipment for decreasing the physical harmful impacts, cleaning the air polluting substances and control its polluting sources when starting to run its activity using the sources which emit polluting substances to the air.

Decreasing the physical harmful impacts shall be controlled by the related branch of Government Administration's Central Organization, soum, duureg Governor and environmental inspector by enforcing the cleaning of the air polluting substances, appropriately equipping all polluting sources and activities.

The organization shall meet the international greenhouse gas emission standards such as carbonic acid, ammonic gas and nitric oxide etc. and use the latest technique and technology while organizing to establish its service activity and enhancing them.

As indicated in the **Law of Mongolia on Water,** the economic entities and organizations who have submitted their applications for water use shall meet the following requirements: to have a construction which is able to clean the discharged water to the standard level in order to reuse the waste water.

Organizations are required to install a certified water meter at the water distribution

Point, have economical technology and pay the water resource usage fees. The customers and users are required to establish and use the facilities such as reservoir, dam, channel, lake and pond etc. which will prevent water disasters such as destruction of water facility, formation of boggy or salinated soil, and increase of the water table etc.

The economic entities and organizations shall submit their application for water use for industrial purposes to the Soum or duureg governor and the application shall include the following items:

1) a map indicating the water source to use and its location;
2) amount of water to be used and duration of use;
3) environmental impact assessment;
4) drawings and project of water facilities;
5) production capacity, technical and economic indications.

Water shall be used by economic entities or organizations for industrial purposes in accordance with a contract.

For protecting water quality and resources, the water user shall keep resources which provide natural and ecological balance, maintain the water source and determine the water restricted zone at the water resource area.

For the effective water use, all water users shall have a water meter. In the event water resources are depleted and water quality degraded due to violations of the water law by water users, technical specifications for the water facilities or technological procedures for water use, the governor of aimag, capital city, soum or duureg shall stop water utilization and require purification and restoration which is to be executed at the expense of the economic entities and/or organizations responsible. The organizations are to have a manager who is in charge of the technological implementation of waste water cleansing procedure and the disseminatation of the effective technology for more than 50 cubic meters water usage a day for water users.

It is prohibited to discard waste, garbage or polluting substances, radioactive contagious and chemical toxic substances into and around water resources, riverbeds, channels, dry ravines, and in protected zones.

The Specialized organization shall develop the draft drawings of the water facility and perform its construction work.

In accordance with the **Law of Mongolia on Water Uses Fees,** the water, minerals and any use of environment ….. the organization will be required to pay water fee.

The percentage of water usage fees was calculated within the following range at the indicated unit which is included in the Chapter 6 of this law.

Charged Water fees	Unit	Range of fees			
		surface water		underground water	
		below	upper	below	upper
1. from the income of the industrial and service organization such as hydroelectric station, water transport, water spread animal, plant growing, tourism, physical culture etc.	%	1.0	5.0	-	-
2. cubic meter for living and drinking water	tug (₮)	-	-	1,00	30.00
3. cubic meter for the water use by citizens, economic entities and organizations water for the industrial and service purpose	tug (₮)	10.00	20.00	30.00	50.00

The water fee payment and reporting shall be charged and implemented within the period indicated in this law. A fee payer shall be exempt from water uses fees for the following purposes and needs:

1. to extinguish a fire;
2. other natural calamity;
3. water reuses to the needs of industrial technology

In accordance with Chapter 8 of the **Law of Mongolia on Natural Plant**, the organization's plant protection and quarantine related responsibilities are implemented as follows:

1. plant protection work on land owned by the organization and/or state-owned land under the control of plant protection authority.
2. inform the plant protection authority and take necessary action at it's own expense, except the occasion which is indicated in the chapter 11.2 of this law in case of insects and rodent extermination, weeding at own and/or state-owned land .

In accordance with chapter 22 of the **Law of Mongolia on Fauna**, take action to coordinate the activities to provide natural balance of animals, protect the population's health and safety, treat the epicentre of a contagious disease and prevent

its spread to domestic animals, prevent any harm to citizens, economic entities and organizations. There is no complication in the legislation while taking the action to provide flight safety due to the permission for taking the preventing action against the influence of rodents on the runway.

In accordance with the **law of Mongolia on Forest and Field Fire Prevention**, the economic entities and organizations' obligations are indicated as follows:

1. to provide the staff, vehicle and related transportation while taking an action to prevent and fight a fire
2. to organize follow-up action in accordance with the law of Mongolia on fire prevention, related authority and officials decision within its activity.
3. to follow firmly a procedure for storing, transporting and using flammable substances.
4. to equip all types of transport means and vehicles with fire fighting and preventing equipment and maintain them.
5. to inform promptly all information to the Governor, related authority and officials upon receipt of fire related information and to take necessary action to extinguish fire depending on the capabilities of the available equipment.

Living and industrial waste of organization shall be kept temporarily at the special rubbish facility and shall be transferred to the special rubbish collection point via related authority which has a power to bury the rubbish under contract and a big amount of rubbish which cannot be stored may transported to the above location under contract.
The organization shall comply with following obligations: to sort out the rubbish, to classify the rubbish at the temporary rubbish point for storage, to provide the right information about rubbish to governmental and local administration authorities, to provide the standard requirements of the waste, to pay completely the waste payment on time, to take a recommendation from the professional organization, to study staff for obtaining the related knowledge of rubbish classification and storage, to provide the safety requirements, to cooperate with citizens, economic entities and

organizations who have the right to transfer the waste under contract and to follow its implementation.

The citizens, economic entities and organizations shall pay the waste fees. The amount of the waste fee shall be approved by Civil Residents Hural of aimag and capital city according to the method approved by Government. The income from the waste fees shall be centralized at the waste service centre of the aimag and capital city.

The Law of Mongolia on the Cite of Ecological Legislation includes several laws which have chapters and items relating to ecological standards however it was approved to coordinate the certain social relations except ecology. The following ecological legislation laws are connected with this project. For example,

- The Civil Aviation Law of Mongolia
- The Law of Mongolia on Construction
- The law of Mongolia on Public Health
- The law of Mongolia on Sanitary
- The law of Mongolia on Safety Condition of Fire
- The law of Mongolia on Labour etc.

As indicated at the **Civil Aviation Law of Mongolia**, the Civil Aviation Authority shall direct its activities toward ensuring safety and security in all civil aviation-related areas. Concerning above the following items shall be implemented, to set up aviation safety standards pursuant to Annexes to Chicago Convention and present
them for approval or registration to relevant authorities and control implementation thereof; and for the purpose of safe operations, the Civil Aviation Authority shall determine the aerodrome security area in consultation with the Governor of the corresponding district or soum; all issues related to use of land of aerodrome security area shall be regulated by the Civil Aviation Regulations. The Civil Aviation Authority shall have a national civil aviation security program for ensuring flight safety**.**

The Law of Mongolia on Construction's articles which is indicated below will connect directly to the new airport activities to protect the environment and restore the land.

- to build a facility
- to cut through a street and a road to restore and maintain the construction
- to make a network connection
- to recover the land and plant after the construction work
- to charge above related work fees
- to take necessary actions to prevent any sudden or possible natural calamity
- to comply with the recommendations and requirements of the related supervising authority of the environment, fire and sanitary etc.

As indicated in the Article 49 of the **Law of Mongolia on Public Health**, the organization's function relating to the public health protection and its support are as follows:

1. to comply firmly with the standard procedure of related health authority for decreasing the loss of labour ability, improving the staff labour and sanitary conditions, and preventing any diseases, specially; poisoning, infection, accidents, damage and professional diseases.

2. to establish certain annual budget into the organizations and its expenditure shall be indicated, which will help to prevent negative impacts to the human health such as industrial and service hygiene, technological condition, product quality and safety activities

There is an importance of the main preventing activity to protect person from the negative influence of the work place condition due to the environmental sanitary and hygiene conditions as indicated clearly in the **Law of Mongolia on Sanitary.**

As indicated at the Chapter 4 of this law, there is a requirement to follow the standard sanitary procedure and norms and to make report on the sanitary, hygiene and other professional organizations' decision while building a structure, choosing the land, creating the draft figure and its exploitation.

Also, the requirement of working and living conditions are indicated clearly in this law. For example, the requirement for providing drinking water is indicated at the Chapter 5 as follows:

- ☆ The citizens, economical entities, local administration and drinking water utilization organization shall determine the restricted zone at the source of
- ☆ public drinking and utility water, water distributing network, reservoir, pumping station, distributing network, and shall take an action for protecting them from the pollution according to the related rule and procedure.
- ☆ The drinking water utilization organization shall control the drinking and utility water quality, and take an action to improve the its quality according to the standard procedure.

Chapter 6. The requirements for the environmental air :

- ☆ The air should meet the standards and sanitary norms for the human life, work, study, and it should not be polluted.
- ☆ The amount of smoke, dust and waste from the industry, economical entities and the vehicles moving at the crowded city area which has more traffic density should fitted with equipment to meet the standards and sanitary norms.

Chapter 7. The requirements for the sanitary of the soil:

- ☆ The land tenure soil at the settlement area should meet with standards and sanitary norms and should not be polluted.
- ☆ The sewage, rest rooms, waste point … etc. should be established and used in accordance with standards and sanitary norms
- ☆ It is prohibited to dump the waste and to pollute environment at a different location than the waste disposal area.

- ☆ The special waste which is harmful for the nature and spread the infection to the humans and domestic animals should be buried or annihilated at the certain location.

Chapter 8. The requirements for the apartment and public service constructions:

- ☆ The apartment and public service constructions should provide standards and sanitary norms, and have no negative impacts to the human health.

Chapter 9. The requirements at the work and study conditions:

- ☆ The industry, service and training conditions, its furnishing and construction equipment should not influence the staff, customers and trainee's health and labour ability, and should meet the safety standards and sanitary norms.

Chapter 10. The requirements for the ray generator with ion and/or without ion, chemical toxic substances etc;

- ☆ The State Administrative Central Organization shall determine the safety regulation of the citizens, economical entities and organizations who are working with radioactive and chemical toxic substances, ray ion and/or without ion, physical items /noise, vibration, electric magnet field, radio wave, excessive noise etc./ generator and laboratory culture of bacteria. And, the Government administration's central organization shall ensure its implementation.
- ☆ The related State Administrative Central Organization and the Sanitary, infectious study and control organization shall supervise the activities for importing, producing, using, storing, transporting, burying and removing the radioactive and chemical toxic substances, ray generator ion and/or without ion, laboratory culture of bacteria, and shall report to them.

Chapter 11. The requirements for the food hygiene:

- ☆ The food production, transportation, storing, purchasing and utilization activities shall be provided food hygiene and quality standards, norms. The citizens, economic entities and organizations who have a special certificate from the health and sanitary organization shall run these public food production activities.

Chapter 12. The requirements for the new products, food preparation materials, substances, technique and technology:

- ☆ The new products, food preparation materials, substances, technique and technology shall include a requirement which has no negative impacts to the human health and nature.

Chapter 14. The requirements for the new products, food preparation materials, substances, technique and technology of the import:

- ☆ The import products, food preparation materials, substances, technique and technology shall be safe and harmless to the human health and nature, and shall have a quality standard license of Mongolia which meets international and region's standard requirements.
- ☆ The citizens, economic entities and organizations shall comply with the Chapter 14.1 and indicate its items to a contract in advance while importing the products,

food preparation materials, substances, technique and technology and shall obtain a permission from the Foreign Trade Department of the State Administrative Central Organization if it is indicated in the law. While passing them through the State border, the contract, the license for import products and its quality guarantee shall be controlled by the State Specialized Supervision Organization at the border.

- ☆ The import products, food preparation materials, substances, technique and technology shall be tested and reported by State Specialized Supervision Organization before use, purchasing them at the industry and market.

Chapter 17. The organization obligations are as follows in this law:

- ☆ To approve and follow the organization's procedure which meets with the Law of Mongolia on Sanitary and related acts.
- ☆ To inform an offence to the related Sanitary and State Specialized Supervision Organization promptly and support them to remove its consequences if there is an emergency harmful condition to the human health and hygiene
- ☆ To implement the requirements relating to the Law of Mongolia on Sanitary from State Specialized Supervision Organization and related inspectors, and inform its implementation on time, and take an action to remove deficiencies completely .
- ☆ Do not pollute the environment.
- ☆ To provide training concerning the human health protection and hygiene culture etc. to all staff.
- ☆ To organize a preventing activity from contagious disease, poisoning, industrial accidents and/or incidents at the economic entity and organization.
- ☆ The economic entity and organization who runs the service, shall take a
- ☆ medical examination of preventing activity for all staff.

For providing **the Safety Condition of Fire,** the following items of this law shall be complied:

- The construction design shall provide the public safety and a possibility to extinguish fire to lessen the loss.
- To obtain an official permission from the Fire Fighting Authority for the purpose of storing and using dangerous fire and explosive substances, flammable materials /fuel station and storing gas etc.
- The officials and citizens have an obligation to comply with the standard which is requirement for the safety from fire and other related technical norms at their work activities.
- To comply with requirements /standards, technical norms/ for the safe condition of fire while drafting the constructions drawings and building it, changing its design, refurnishing the technique and technology.
- To prohibit accepting the construction, which does not comply with satisfactory requirements for the fire safety.
- The citizens and economical entities who will produce and purchase products which have a fire danger, shall inform its activity to the Fire Fighting Authority and to obtain an appropriate permission under their duty.

- The meteorological and other related organizations have to inform promptly about a possible condition of the natural calamity such as heavy storm, flooding, drought and earthquake etc. to the Fire Fighting Authority. The information shall be without payment.

According to **the Labour Law of Mongolia,** the working conditions, safety and sanitation standards should follow as below:

- An employer shall provide an employee with favorable working conditions and ensure that chemical, physical and biological conditions resulting for production processes will not have a negative impact on safety, sanitation, or the natural environment.
- An employer shall provide employees working under abnormal working conditions with protective equipment, special working garments, and poison antidotes.
- The organization of work shall meet the requirements of the relevant production technology and comply with applicable safety and sanitation requirements. Toxic or hazardous chemical, physical, or biological conditions in the workplace shall not exceed the permitted labour and sanitation standards.
- The design of production buildings and facilities, and proposals for construction, renovation, expansion and the hand-over for use of such facilities, shall be approved and licensed by the relevant professional organization in charge of labour safety and sanitation.
- The installation of machinery and equipment, and continued use after major repairs have been made to such machinery and equipment, must be examined and approved by the relevant professional monitoring organization.
- Machinery for lifting and transportation, as well as pressurized containers, pipes and channels, must be periodically tested and certified as safe, in accordance with the relevant regulations.
- Electrical equipment must be installed as specified in applicable project documents and comply with all applicable use and safety requirements.
- An employer shall adopt and comply with internal fire safety rules. Business units and organizations with fire alarm systems and fire extinguishers shall keep such equipment in constant working order and train their employees in the use of such equipment. An employer shall take all required measures necessary to prevent fire in the course of production.
- An employer shall arrange for employees to receive regular preventative health examinations necessary for and related to their work performance in accordance with regulations promulgated by authorized organizations. An employer shall provide all pertinent information the employer has concerning an industrial accident, or the occurrence of an occupational disease or poisoning.

The **Constitution of Mongolia**, Article 10 is as follows: “Mongolia shall adhere to the universally recognized norms, and principles of international law; ….. The

international treaties to which Mongolia is a Party, shall become effective as domestic legislations upon the entry into force of the laws on their ratification or accession".
It is an expression to certify that the norms and principles of international law are one of the units of the legislation of Mongolia. The law and/or the legislation acts are an origin of ecological legislation. For example, resolution, order, ruling and the procedure, introduction and standards approved by above resolution and order. These acts will be a base of theory to use the regulation. In that case, it has a standard characteristic which determines the detail mechanism to use the regulation items based on legislation.

The related resolution, order and the procedure, introduction, standards approved by this order and resolution are used widely at the detailed environmental impact assessment work.

REFERENCE

1. G.Baasankhuu and P.Gomboluudev. Some significant features of temperature inversion over territory of Mongolia. Scientific paper of Institute of Meteorology and Hydrology, No 18, 1996 p41-46.
2. D.Dorjgotov, D.Batbayar. "Soil classification of Mongolia". UB., 1986.
3. D.Dorjgotov. "The soil of Mongolia" UB 2003.,
4. Report on expert assessment, conclusions, Ministry for Nature and Environment
5. Holzworth, G.C., 1972: Mixing Heights, Wind Speeds and Potential for Urban Air Pollution Throughout the Contiguous United States. Publication No. AP-101, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711.
6. Law on Environmental impact assessment
7. The Mongolian governmental policy on ecology, Decree No. 106, 1998, Mongolian Parliament.
8. State of environment, 2003, 2004 (Ministry for Nature and Environment, press-release)
9. Statistic yearbook of Mongolia, Ulaanbaatar, 2006
10. Mongolian fauna, I volume, Insects, 1990, Ulaanbaatar.
11. Jambaajamts B. Mongolian climate, 1969, Ulaanbaatar.
12. The information book on Mongolian climate, 1970, Ulaanbaatar.
13. Ulziikhutag N. Vegetation of Mongolia, 1986, Ulaanbaatar.
14. Dorjgotov D., Batbayar D. Mongolian soil classification system, 1986, Ulaanbaatar.
15. Soil cover and soils of Mongolia, Biological resources. Mongolian conditions, 1984., Moscow.
16. The methodology of environmental impact assessment, 2002, Ministry for Nature and Environment.
17. The laws on protection from poisonous chemicals, 2002, Ministry for Nature and Environment.
18. The legislation related with public health, 2004, Ministry of Health, Ulaanbaatar.
19. The methodological handbook on estimation of polluting substances released into atmosphere by different industries, 1986.
20. The protection of atmosphere from industrial pollution, manual, volume 2, 1988, Moscow (translated from English).
21. James Gurganus, Malt Pearson. Environmental Assessment Resource Guide. USA. EPA Region 5.
22. World Bank. Environmental Assessment Source book, 6 Volume I,II Sectoral Guidelines. Environmental Department. USA Washington 1991.
23. Brief of flora of Mongolia A.A.Yunatov, 1950 N. Ulziikhutag, 1989
24. United Nations. ESCAP - Environment and Development Series. Environmental Impact Assessment Guidelines for Mining Development. USA. New-York. 1992.
25. User's guide for the industrial source complex (ISC3) dispersion models, Volume I – User instructions, U.S. ENVIRONMENTAL PROTECTION AGENCY, Office of Air Quality Planning and Standards, Emissions, Monitoring, and Analysis Division, Research Triangle Park, North Carolina 27711, September 1995
26. User's guide for the industrial source complex (ISC3) dispersion models, Volume II - description of model algorithms, U.S. ENVIRONMENTAL PROTECTION AGENCY, Office of Air Quality Planning and Standards, Emissions, Monitoring, and Analysis Division, Research Triangle Park, North Carolina 27711, September 1995
27. Establishing Airport Noise Compatibility Polices. Chapter 7. 2002